



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

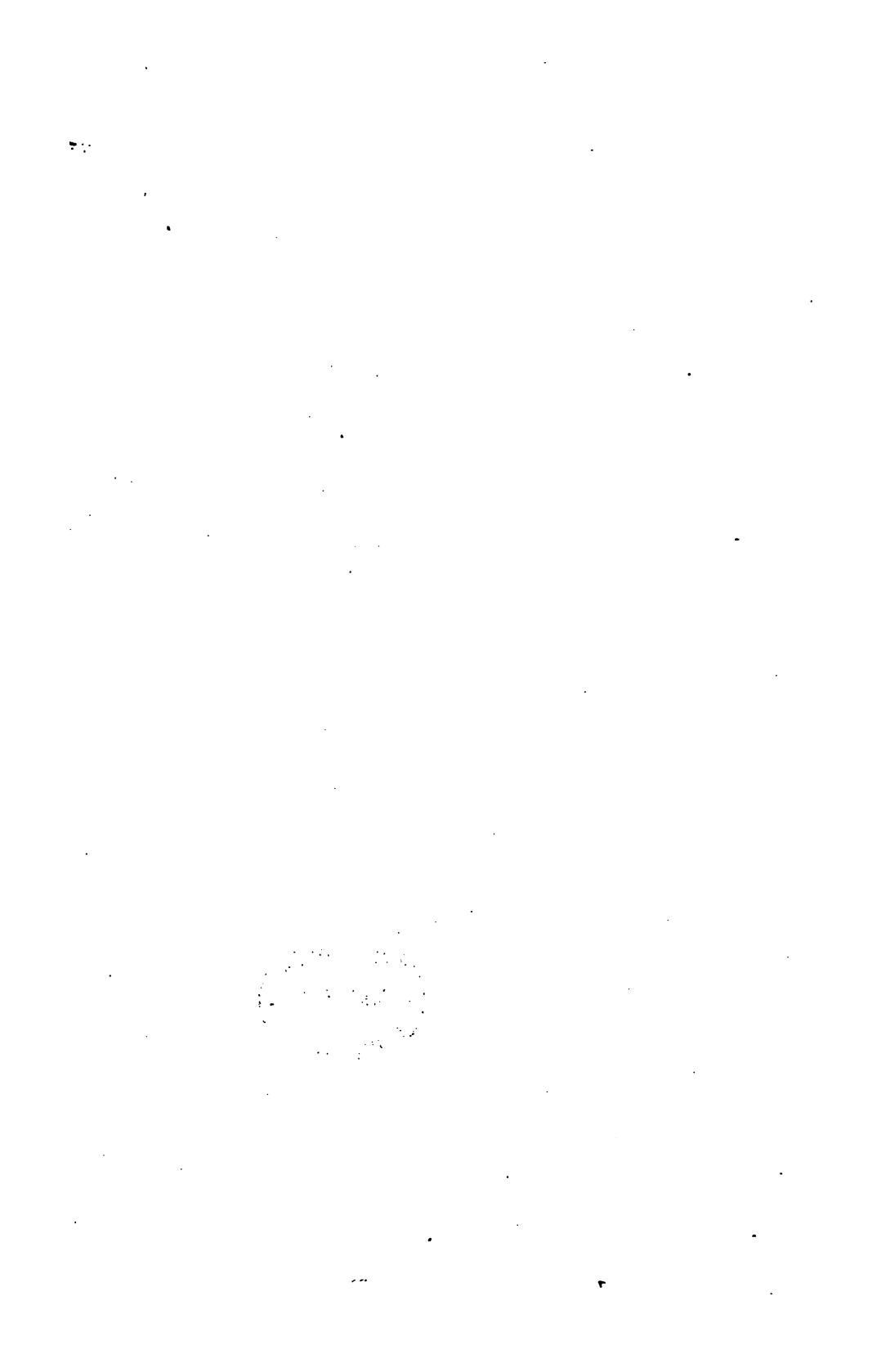
About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>

REMARKS ON RATING
AND ON THE TRANSFER OF
WATER UNDERTAKINGS
FROM
PRIVATE TO PUBLIC
AUTHORITIES

JOSEPH QUICK JUN





SECOND EDITION.

REMARKS

ON

**THE RATING OF GAS AND
WATER WORKS,**

AND ON

THE PRINCIPLES OF COMPENSATION

INVOLVED IN

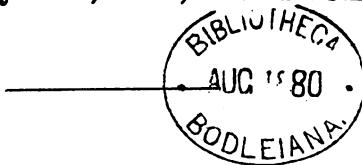
**THE TRANSFER OF WATER
UNDERTAKINGS**

FROM

Private to Public Authorities.

BY

JOSEPH QUICK, JUN., M. INST. C.E.



**LONDON:
E. & F. N. SPON, 46, CHARING CROSS.**

**NEW YORK:
446, BROOME STREET.**

1880.

Price, Half-a-Crown.

LONDON
PHIPPS & CONNOR, PRINTERS, 13 & 14, TOTHILL STREET
WESTMINSTER

PREFACE.

ALTHOUGH at the present time there exist several most comprehensive and erudite works on the Law and Practice of Rating, which are highly appreciated by those professionally interested in the subject, a desire has been frequently expressed by laymen, and more especially by the Members of Assessment Committees, that general information as to the principles of rating public undertakings should be published in a concise form ; the author has therefore endeavoured to accomplish this object as far as practicable within the limits of a pamphlet, by an exposition of the mode now generally adopted in the rating of Gas and Water undertakings, premising, however, that, although necessarily varying in detail, the same general principles are equally applicable in the case of Railways and public works generally.

The question of the transfer of Water Works undertakings from private to public authorities has become so prominent during the last few years that the Author trusts that his remarks upon the subject may prove in some degree useful to those interested, either as Shareholders in Water Companies or as representing the interests of the public on the all-important question of Water Supply.

J. Q., Jr.

29, GREAT GEORGE STREET,

WESTMINSTER,

February 1880.

CONTENTS.

PART I.

	PAGE
Remarks on the Rating of Gas and Water Works	1—25

PART II.

Remarks on the Principles of Compensation involved in the Transfer of Water Undertakings from Private to Public Authorities	26—51
---	-------

ADDENDUM.

Proposed Purchase of the Metropolitan Water Com- panies by the Government	52—57
--	-------

PART I.

REMARKS

ON THE

RATING OF GAS AND WATER WORKS.

ACCORDING to the Law of England the expense of maintaining the poor is chargeable upon all descriptions of real as distinguished from personal property, and although, with one exception, the Acts of Parliament relating to this subject do not give a definition of the term real property or "hereditament,"* it is well established by custom that for rating purposes it includes all descriptions of fixed capital vested in land, the occupation of which is beneficial to the owner; in other words, which would command a certain *rent* from anyone not being necessarily the owner, but the *occupier* of such property or hereditament. The general basis being thus clearly established, subject to points of detail, the whole subject resolves itself into the question of the amount of rent which would be given for any particular property, whether such lie in the nature of land, houses, railways, gas or water works, canal, docks, or in fact any property other than personal.

The meaning of the term "rent" is defined, so far as rating purposes are concerned, by the Act of 6 & 7 William IV., cap. 96, which defines the "net annual value" of the rateable hereditaments as "the rent at which the " same might reasonably be expected to let from year to year

* The definition of "Hereditament," contained in the Schedule to the Valuation (Metropolis) Act, 1869, is as follows. "The term 'hereditament' means any lands, tenements, hereditaments, and property which are liable to any rate or tax in respect of which the valuation list is by this Act made conclusive."

" free of all usual tenants' rates and taxes, and with com-
 " mutation rent-charge, if any, and deducting therefrom
 " the probable average annual cost of the repairs, insurance,
 " and other expenses, if any, necessary to maintain them
 " in a state to command such rent." This definition was
 confirmed so recently as 1862 by the Union Assessment
 Committee Act of 1862, where the following clause occurs :
 " The *gross estimated rental* for the purposes of the Schedule
 " to this Act shall be the rent at which the hereditament
 " might reasonably be expected to let from year to year,
 " free of all usual tenants' rates and taxes, and tithe commu-
 " nation charge, if any, provided that *nothing herein*
 " contained shall repeal or interfere with the provisions
 " contained in the 1st Section of the said Act (6 and 7 Wm.
 " IV., cap. 97), defining the net annual value of the heredita-
 " ments to be rated."

Although the Acts of Parliament above quoted have reference only to the value of the hereditament for the purpose of determining the assessment for the poor rate, they are frequently accepted as those upon which other rates are made, as, assuming them to be carried out justly, they furnish the most reliable basis for this purpose.

The practical difficulty in the application of the above principles to the assessment of public undertakings, such as gas and water works, lies in the fact that such undertakings, although sometimes let upon lease for a term of years, are absolutely never let to a tenant from year to year; but as the Act is precise upon this point, it becomes necessary to assume a hypothetical tenant, and to consider what rent such a tenant would give for the property *from year to year*.

The general principles by which the net rent which would be paid by a tenant for the occupation of a gas or a water works is arrived at only vary from those applicable to the ordinary yearly tenancy of a house, by the fact that in

the latter case the tenant would not be required to incur any outlay or personal trouble or risk in order to enable him to realize the rent which he would pay to his landlord, his rent being such as he would consider it would be worth his while to pay for the enjoyment of the premises occupied, free from all anxiety or trouble to himself. All in fact that the tenant would have to do would be to pay the rent for such enjoyment, leaving all the trouble and responsibility of repairs, insurance, depreciation, and eventual renewals to be dealt with by the landlord. In the case of a tenant taking a house on repairing lease, the same principle would apply, but with this difference, that in such case in order to arrive at the gross estimated rental the nominal rent which he would pay would be increased by such sum as would cover the expense of repairs and insurance, &c.; and the rateable value should in that case be the amount of the rent actually paid, less an allowance to the landlord for depreciation, depending upon the structural condition of the premises, the length of the lease to the tenant, and other local considerations. These allowances are known technically as "imperceptible depreciation," and are based upon the fact that, notwithstanding that repairs may be done and premises kept in a perfectly habitable condition, the time will come when certain parts, or even the whole structure, will require to be renewed; these statutable deductions, should be, as a rule, the same independently of the nature of the tenancy—the words in the Act being, "*deducting therefrom*" (i.e., from the gross annual rental) "*the probable average annual cost of the repairs, insurance, and other expense, if any, necessary to maintain them*" (i.e., the premises) "*in a state to command such rent.*"

It will, however, be readily understood that in the case of houses (which form a large portion of the rateable value of the property in every Union) this strictly legal deduction

is practically ignored, or rather that experts have arrived at the same result, but by a less circuitous route, and that in estimating the annual allowances for repairs, &c., a sufficient sum is included to cover this "imperceptible depreciation."

In one instance also, the Metropolis Valuation Act, 1869, the Legislature has followed suit in this respect, for in the third Schedule attached to that Act, under the head of percentage or rate of deductions to be made from the gross value in calculating the rateable value, the maximum rate of deductions for various classes of buildings and land is specified, but no attempt is made to apply the principle to gas or water, or, in fact, any public works.

The following is a copy of the Schedule referred to :—

THIRD SCHEDULE,

Showing the several classes into which the hereditaments inserted in a valuation list under this Act are to be divided.

	Maximum rate of deductions.
	Per cent. or proportion.
Class 1. Houses and buildings, or either of them, without land other than gardens where the gross value is under £20	25 or $\frac{1}{4}$ th.
,, 2. Houses and buildings without land other than gardens and pleasure grounds valued therewith for the purpose of inhabited house duty where the gross value is £20 and under £40	20 or $\frac{1}{5}$ th.
,, 3. Houses and buildings without land other than gardens and pleasure grounds valued therewith for the purpose of inhabited house duty where the gross value is £40 or upwards	16 $\frac{2}{3}$ or $\frac{1}{6}$ th.
,, 4. Buildings without land which are not liable to inhabited house duty and are of a gross value of £20 and under £40	20 or $\frac{1}{5}$ th.
,, 5. Buildings without land which are not liable to inhabited house duty and are of a gross value of £40 or upwards	16 $\frac{2}{3}$ or $\frac{1}{6}$ th.
,, 6. Land with buildings not houses	10 or $\frac{1}{10}$ th.
,, 7. Land without buildings	5 or $\frac{1}{20}$ th.
,, 8. Mills and manufactories	33 $\frac{1}{3}$ or $\frac{1}{3}$ rd.
,, 9. Tithes, tithe commutation rentcharge, and other payments in lieu of tithe	To be determined in each case according to the circumstances and the general principles of law.
,, 10. Railways, canals, docks, tolls, water-works, and gasworks	
,, 11. Rateable hereditaments not included in any of the foregoing classes	

The maximum rate of deductions prescribed in this schedule shall not apply to houses or buildings let out in separate tenements, but the rate of deductions in such cases shall be determined as in Classes 9, 10, and 11.

We shall have occasion to refer to this question of "imperceptible depreciation" in its application to gas and water works later on, as it becomes a most important element in considering the rateable value of such undertakings and is frequently one of the chief causes of disagreement between the professional experts engaged in cases of disputed assessments.

The annual *rent* which a tenant would give for a Gas or Water Works naturally depends upon a variety of local conditions, but one thing may be regarded as certain, viz., that no one would enter upon such an undertaking unless he could see his way clear, not only to get a fair interest for the capital he would be obliged to invest, but also some remuneration by way of trade profit or compensation for his time and trouble. This principle is now practically universally acknowledged, and acted upon even to the extent of the percentage allowed in respect of these items being agreed; but the important question of the *amount* of capital which it would be necessary for a tenant to provide, and on which he should receive his interest and trade profit, is always a fertile question of dispute.

The first question which arises upon this point is, how much money the tenant would have to be out of pocket before he could be in receipt of the gas or water rents from the parties supplied, and this would again depend upon the nature of the works, and the practice as to the collecting of such rents, whether quarterly, half-yearly, or otherwise. It is ordinarily the case that the rents are collected half-yearly. In such case the tenant must obviously start with sufficient capital to pay the working expenses for not only six months, but also for the additional time it would take him to get in his rents, which would probably average another three months, so that, if the working expenses of the concern were, say, £5,000 for the half-year, he would require

£7,500 in respect of this item; but in addition to this he would want capital for many other purposes, *e.g.*, the purchase of office furniture, stock of coals, and materials in case of accident, spare gear, and the tools and implements necessary for carrying on the business, and (last, not least) for the payment of rent to his landlord. On all these questions conflict of opinion frequently arises, although many points formerly in dispute have now been practically settled. In the case of Gas Companies this was especially the case, for it was even contended in *The Phoenix Gas Company v. The Parish of Lee* (1 Law Reports, Q. B. 241), that the retorts, the exhausters, steam engines and boilers, the condensers, the scrubbers, the purifiers, the gas holders, and the meters were to be deemed tenant's property, and, therefore, not only were not rateable, but that a tenant would require to provide the necessary capital to purchase them, and would be entitled to deduct his interest and trade profit, and casualties on such capital, from the net rateable value of the concern. The whole of these items were disallowed by the Court, on appeal, with the exception of the meters; which were held to come under the denomination of *tenant's chattels*, as distinguished from *landlord's fixed plant*.

The amount of tenant's capital, however, being arrived at, it is usual to allow interest upon it at 5 per cent., tenant's profit 10 per cent., and contingencies $2\frac{1}{2}$ per cent. for the *occupier's share* of the net receipts remaining, after deducting from the gross receipts, arising from the sale of the gas or water, the working expenses. *This result, i.e., the gross receipts, less the working expenses and the occupier's share of the remaining balance, is the GROSS ESTIMATED RENTAL OF THE ENTIRE CONCERN.*

We have now to revert to the item already referred to in the early part of our remarks, under the head of "Imperceptible Depreciation," or as it is usually termed

“Statutable Deductions,” *i.e.*, deductions which the landlord is entitled to make from the gross estimated value for the expense of maintaining the premises in a state to command the rent from the yearly tenant. As already explained, the justification for these deductions lies in the fact that, even although it is assumed that the buildings, machinery, pipes, &c., are kept in a proper state of repair by the tenant, and the cost of such repairs has been duly taken into account in determining the rent to be paid, there will, nevertheless, come a day when it will be necessary to absolutely *replace* the various buildings, machines, &c., by new ones altogether.

We do not mean to convey that it will be necessary to rebuild the works as a whole *simultaneously*, but to replace with new the various portions as each becomes worn out. The practical mode of dealing with this question is to determine the “life” of each part of the works and to set aside such a sum per annum as would if reinvested at the end of each year suffice to replace each part at the expiration of its “life.” Thus for instance, if it be assumed that a boiler costing £500 will last 20 years, it will be necessary to provide a sinking fund of £15 per annum, and to reinvest the sum and interest thus accumulated each year, so that at the end of 20 years it will have reached the £500 required for the expense of the new boiler. In this calculation we have assumed that the money can be reinvested at 5 per cent. interest, but this will vary according to circumstances.

It will be apparent, from the above, that to arrive at the proper amount of the statutable deductions, it is essential that great care be taken to obtain accurate information upon the points alluded to, and the more especially when it is remembered that no “hard and fast” line can be laid down for the “life” of any of the parts of a gas or water

works, as very much will depend upon the original mode of construction of the works, and the wear and tear to which they are subjected in practice.

It is frequently a matter of surprise to those who are not familiar with rating business that the "life" of the apparatus is calculated upon the assumption that it is, so to speak, in its infancy, and has its full term to live, the question of *how long it has already lived* being left out altogether. And it is argued that the "statutable deductions" should be calculated upon the number of years that each part of the apparatus has yet to live; but the obvious answer is that if the apparatus has not been kept in proper repair the owner has had the benefit of the assumed deduction in previous years, *i.e.*, from the time when the apparatus was new; the same argument is especially applicable in the case of old erections, more especially houses.

The amount which the landlord is thus entitled to under the head of "statutable deductions" constitutes the difference between the "gross estimated" and the "net rateable" value of the undertaking as a whole. Before proceeding to consider how this is to be apportioned in the case of the works and mains of a Company not being situated within the same parish or union, it will, we think, be convenient if we present to our readers an outline *r  sum  * of the process which we have described.

NAME OF COMPANY.

Gross Receipts for the financial year ending	£
Less current expenses	£
Rates and Taxes	£
NET RECEIPTS	£

OCCUPIER'S SHARE—

Working capital, and tenant's plant, fur- niture, &c.	£
Interest thereon	£
Trade profits do.	£
Risks and casualties	£
GROSS ESTIMATED RENTAL	£

STATUTABLE DEDUCTIONS—

Average annual repairs and sinking fund necessary to replace perishable parts of the works	£
Do. Do. Tenant's plant £	£
Insurance	£

NET RATEABLE VALUE OF THE
WHOLE CONCERN £

Now if, as is the case with numerous comparatively small undertakings, it happens that the whole of the Company's works, stations, and mains are all situated in one parish or union, no question arises as to the subdivision of the net rateable value; but where, as in the

case of many provincial towns, and notably in the Metropolis, it happens that the Company's stations and mains and the district in which the revenue is earned are spread over a great number of parishes, it becomes necessary to apportion the net rateable value of the gas or water works amongst those parishes. As the result of a great deal of litigation upon this part of the question, it is now generally accepted that the equitable mode of determining it is by dividing the works in two parts, viz., those which *indirectly* and those which *directly* contribute to the earnings of the Company, and after apportioning to the former a fair interest upon their value deducting this amount from the rateable value of the whole, and then dividing the balance amongst the parishes in which the rental is obtained in the proportion respectively received in each. The question, therefore, at once naturally arises how to distinguish between those portions of the works which are respectively to be classed as *indirect* or *direct* contributors to the Company's earnings.

Happily, this point, upon which there existed formerly very grave doubt, has been, to a great extent, set at rest by the various decisions which have been given in the Courts, notably in the case of "*The West Middlesex Water Company v. The Parish of Hampton*," and it is now generally conceded that the indirectly earning portions of the undertaking are the works, machinery, fixed plant, and *those mains which are not tapped by service pipes*. This latter definition is not strictly accurate (although generally accepted as correct), as mains may, without being *actually* tapped, have branches connected to them to supply smaller street mains which are subject to the actual "tapping;" but it is none the less by means of the larger main that the consumer is supplied. Strictly speaking, indirectly earning mains should be described as those which act as conduits, to convey the gas or water from one point to another for the

purpose of its distribution by the *de facto* supply pipes in any district. The *directly earning* portion of the works should be consequently limited to those distributory street mains and street service pipes which actually supply the gas or water to the consumers.

To illustrate this, let us suppose that the works of a Company are situated in parish A (but that no gas or water is supplied within that parish); from the works in parish A, a main is laid through parish B (where also no revenue is earned) into parishes C, D, and E, where the distributory mains and pipes are laid and the consumers supplied. The works in parish A and the mains in parish B would come under the category of *indirect* contributors, and the distributory or productive pipes in parishes C, D, and E of *direct* contributors.

This division being made, the indirect portions should be rated at such a percentage upon their *commercially* structural value as the nature of the security would be likely to command in the market, which usually varies from 4 to 5 per cent.,* and the balance remaining, after deducting this from the net rateable value of the whole concern, is the rateable value of the *directly* earning part of the works, *i.e.*, the distributory or "productive" mains and street service pipes, which balance, as previously explained, has to be apportioned amongst the parishes in which the gas or water is actually sold. Thus, to continue our illustration, if we suppose the value of the works in parish A were, say, £50,000, the main or conduit in B, say, £10,000, the net rateable value of the whole concern £5,000, and the gross receipts, £20,000 divided amongst the parishes of C, D, and E in proportions of £10,000, £6,000, and £4,000 respectively, the result would be as follows:—

* A generally recognized principle is not to rate the "indirectly productive" portions at a higher percentage on their structural cost than the rateable value of the whole concern bears to the structural cost of the whole concern.

NET RATEABLE VALUE OF WHOLE CONCERN £5,000

VALUE OF WORKS in—

Parish A, £50,000 at 5 per cent.	£2,500
, B, £10,000 at 5 per cent.	500
Rateable value of stations	£3,000
Leaving rateable value of distributory or “productive” mains	£2,000

which should be divided amongst the Parishes C, D, and E as follows :—

	Gross Receipts. in all Parishes.	Receipts in Parish.	Net Rateable Value of Productive Mains in all Parishes.	Net Rateable Value of Productive Mains in Parish.
	£	£	£	£
Parish C .	20,000 .	10,000 .	2,000 .	1,000
„ D .	20,000 .	6,000 .	2,000 .	600
„ E .	20,000 .	4,000 .	2,000 .	400

Although the principle of apportionment must always remain the same, the circumstances connected with it are of a very varying nature: for instance, it frequently happens that in the same parish may be comprised both productive and unproductive mains, and in that case separate calculations have to be made for each, and the sum of the whole will represent the portion of the rateable value due to that particular parish.

Again, in the case of a water works, the value of the land occupied may be considerably enhanced by there being springs of water issuing upon it, by reason of which it would command a much higher rent, for the purposes of a water works, than adjacent land not possessed of such springs. A notable case confirming this principle was that of “*The Parish of Amwell v. New River Company.*”

On the other hand, instances are not wanting where (in

the judgment of the writer) the stations of Gas and Water Companies are rated very considerably in excess of what they legally should be: for instance, the author is aware of an instance of a large Water Company which formerly supplied between forty and fifty gallons per head per day to its customers. It is almost needless to point out that a considerable portion of this supply was wasted in consequence of the imperfect water apparatus furnished by the water consumers; by strict supervision, and the substitution of proper in place of the defective fittings, the consumption of water was reduced to sixteen gallons per head or about one-third of the previous supply, and it then became apparent that new reservoirs and mains, which had been constructed at vast expense, were, in reality, and would be for a considerable time, works of surplusage, in fact, no longer formed an essential part of the undertaking; in such a case it is evident that a tenant renting the undertaking would not derive any benefit from these works of surplusage—and although, therefore, it would not make any difference in the amount at which the undertaking should be rated as a whole, the division of the relative amounts payable to the various parishes in which the works and mains are situate would differ considerably from the present custom in which it is generally assumed that the whole of the works as they exist are a necessity to a tenant. The same argument applies in the same cases where provision has been made not only for the *present* but for the *future* demands upon the works. The practical effect of this would be, as a rule, to *increase* the amount of rateable value in those parishes where the distributory mains are situate, and to *decrease* the rateable value on the works and stations, until such time as the surplus works become essential, and contribute their share to the earning of the revenue.

But, as will have been gathered from the preceding

remarks, the chief difficulty to be dealt with is the want of combination amongst the various parishes in which the works and mains of the Company are situate, and so long as this continues the result will remain that the undertaking is underassessed: the solution would appear to be that the parishes should in the first instance coalesce and obtain for their joint benefit an impartial rating valuation of the undertaking in question *as a whole*, and upon the basis of this rating the total amount should be sub-divided according to the rights, now well understood as already explained, of each parish respectively, always bearing in mind, however, that the total of these subdivisions must not exceed the rateable value of the whole concern.

If this principle were applied the result could not fail to be a very considerable addition to the amounts received from public Companies to the poor and other rates. In fact it is the only mode of adjusting the matter equitably; as long as *separate* in lieu of *united* action continues, so long will the aggregate amount of the taxation paid by public Companies be below what it should be.

We shall have occasion to refer to this very important matter in the subsequent chapter, when considering the bearing of the question in the case of the purchase of the works of private Companies by public authorities, for there can be no question that under the present very lax system of assessing these public undertakings, the amounts which they contribute towards the poor and local rates are very considerably below those to which they are legally subject. This is more especially the case in the Metropolis and larger provincial towns where, in consequence of the want of combination amongst the various parishes in which the works and mains are situate, *the aggregate amount of the rateable value, as assessed by the parishes separately, falls far short of the rateable value of the whole undertaking.*

The fault cannot, however, be attributed to the Companies who contribute too little, but rather to those who have the making of the assessments, and are not aware of the true basis on which the law authorizes them to make their calculations, which from their very nature must be more or less intricate.

On the other hand, it is our constant experience that, especially in the case of *small* gas and water undertakings, the rateable value is fixed at much too high a figure, mainly in consequence of the very prevalent but altogether incorrect notion that the rateable value should be assessed according to the *profits* divided amongst shareholders, on whom an undue share of taxation consequently falls.

Hitherto we have considered only those cases in which the gas or water works are the property of a Company entitled to make either unlimited profits, or, if erected under the authority of an Act of Parliament, the maximum amount of profits authorized by such Act. We have now to consider the cases where it happens that the works are the property of a Corporation, or other local authority, and where they are carried on, not for the sake of profit, but, on the contrary, are in some instances expressly prohibited from levying more rates from the inhabitants than will suffice to pay the interest on outlay, working expenses, and the cost of maintenance of the works.

In this category are included both those cases where the works have been originally constructed by the local authorities, and those which the local authorities have subsequently acquired by purchase.

At first sight it would appear that, the works being presumably carried on by the local authority for the joint benefit of their whole constituency, no profits as such could be earned, and therefore, no tenant, hypothetical or other-

wise, could be assumed as being willing to give a rent for them ; and this in one sense is so, but on the other hand it not unfrequently happens that, especially in the case of *gas*, a considerable profit arises from its manufacture, and that in place of such profit leading to a reduction in the price of the gas, it is applied in aid of the general or district rates. The same practice is adopted in cases where, as frequently happens with water undertakings, the local authority acquires, as part of its purchase, the Parliamentary privileges as regards scale of charges previously possessed by the selling Company, and where there consequently remains a surplus profit after the payment of working expenses, interest on borrowed capital, and sinking fund for its redemption.

This is not the place to enter into the question of whether this is or is not an equitable arrangement for the gas or water consumers, but for rating purposes it is of the last importance, the question of whether such works, when carried on by a public authority for the common benefit and without profit, are liable to be rated at all, having been recently brought prominently forward and a decision favourable to the principle of their exemption from taxation altogether given by the Court and confirmed on appeal. This decision has, however not been allowed to pass unchallenged by many experienced authorities on rating law, the more especially as the cases submitted both to the Court below and the Court of Appeal raised the point at issue in a very imperfect form.

The case referred to is that of "*The Corporation of Worcester v. The Droitwich Union Assessment Committee, 1876*" (L.R. 2 Ex. Div., 49. 46 L.J.M.C., 241), where the water works for that city had been constructed by the Corporation of Worcester under the powers of the Public Health Act, 1848, and were carried on by them for the

common benefit of the inhabitants of the city, and subject to the restriction of the Act, which limits the water rates to be levied to the actual expenses incurred for supplying the water and the maintenance of the works notwithstanding which restriction however, the Corporation did actually receive a sum of £651 surplus on the average of years over and above the working expenses and interest and sinking fund on capital.

The Assessment Committee of the Droitwich Union claimed to rate portions of the water works within their district at £1,750 gross, and £1,400 rateable value, and the Corporation of Worcester appear to have agreed that, if rateable as a commercial concern, this valuation was reasonable, but they argued that, inasmuch as they were not allowed by the Act to make a profit, no tenant, hypothetical or otherwise, would be willing to pay any rent for the water works, and that consequently they were not liable to be rated.

If the argument of the Corporation had ended there, it would have given the opportunity of a definite decision being given upon the whole question as to whether, under the circumstances of a water works being carried on by a Public Authority, not entitled to make a profit, but only carrying on water works for the joint benefit of their constituents, it was liable to be rated at all. Unfortunately, the case was complicated by the fact that the amount actually received for water rates had for some years exceeded the annual expenses, after payment of interest and sinking fund on capital, by an average of £651 per annum ; and the litigants agreed that, in the event of the decision of the Court being favourable to the appellants (the Corporation), the assessment should be reduced from £1,750 gross and £1,400 net to £600 gross and £540 net rateable value ; and as this proved to be the case, the result of the proceedings was that the valuation was reduced accordingly. This was

unsatisfactory in the extreme, as it is evident that either the whole concern was rateable in the ordinary way or it was entitled to exemption from taxation altogether; the fact of the Corporation having received more money from the rates than they were legally entitled to should not have been made the basis of a rate on that *illegal* surplus. It must, however, be remembered that this was a matter of arrangement between the parties, and not a decision of the Court; and it is much to be regretted that the Corporation, having carried the matter so far, and figured as the pioneer of reform in the matter, should not have followed out the legal consequences of the decision to its ultimate issue, as soon as the period for which they had previously consented to the payment on the reduced assessment had expired.

Although it is most desirable that this extremely important question should be determined by the highest tribunal in the land, it would, to a great extent, have been unfortunate had it been resorted to in the instance referred to, as the issue was not sufficiently well defined, in consequence of the private arrangement already mentioned as having been come to between the parties, and as those arrangements must have formed part of the case submitted to the House of Lords, the decision would still, even if favourable to the Corporation, have left them liable to be rated at the reduced amount agreed upon. But it is earnestly to be hoped that it will not be long before a simple case to determine the principle as to whether a Corporation or public body carrying on a water or gas works, and authorized only to collect such an annual amount from the inhabitants in the district as will pay for the annual expenses, to the exclusion of any profit whatever, can claim exemption from local taxation.

The arguments *pro* and *con* have each their respective advocates amongst those most experienced in the matter,—

on the one hand it is contended, on the admitted principle as laid down frequently by the Judges, that the tenant from year to year will only give such a rent as the restrictions imposed by Statute will enable him to earn, and that as no profits are allowed to be made beyond the actual expenses incurred for furnishing the article supplied, no tenant would be forthcoming upon such conditions; and it is, therefore, impossible to assume a hypothetical one, and that as a consequence there can be no rateable value: while on the other side, it is argued, that inasmuch as the rates authorized to be levied include not only the working expenses, but also interest on the amount borrowed to construct or purchase the works, and to provide a sinking fund for the ultimate repayment of the outlay within a given number of years, that the amount of such interest and sinking fund, in *fact*, of all authorized income beyond the working expenses and statutable deductions for renewal of works, would represent the rent which a tenant would give for the works, less the amount which he would require for his own remuneration and interest on the working capital which he would have to provide.

The obvious ultimate result would, however, be that in proportion as the amount originally borrowed to construct or purchase the works was paid off, and the amount authorized to be levied annually from the inhabitants reduced, the rent which a tenant would give would gradually diminish until, in the event of the whole cost of the works being paid off, the rent, and consequently the rateable value would be nil—i. e., that as there would be no statutable authority under which the inhabitants could be called upon to pay water rates beyond the actual working expenses it is obvious that no tenant could be found to pay rent for them.*

* See a paper read by Mr. RYDE, the well-known rating authority, upon this case before the Institution of Surveyors, 1878.

In concluding our remarks, we trust that we may have been successful in throwing some light upon this important subject, and that the exposition which we have here attempted may be the means of bringing about a better understanding of the principles involved, and, consequently, a more equitable division of the burdens which of necessity fall upon the owners of property in this country.

PART II.

REMARKS

ON THE PRINCIPLES OF COMPENSATION INVOLVED IN
THE TRANSFER OF WATER WORKS UNDER-
TAKINGS FROM PRIVATE TO PUBLIC
AUTHORITIES.

The question of whether it is desirable that our water supply should be carried on under public administration or entrusted to private enterprise has long been a matter of controversy. It is contended by the advocates of the former that the supply of one of the first necessities of life does not form a legitimate subject for commercial enterprise, and that in the interests of the whole community an abundant supply of pure and wholesome water should be placed within reach of every person, and at the lowest practicable cost, any profit derived from such supply necessarily acting as a direct obstacle to the free use of water for ablutionary and sanitary purposes. On the other hand it is argued that whereas private enterprise is amenable to the criticism of the public and the local governing body of the district supplied, such criticism, either wholly or to a great extent, disappears when the water supply is administered by the local governing body, and that, as a consequence, improvements in the supply which a private company would have been compelled to carry out are either omitted altogether or unduly delayed to the detriment of the consumer.

It is further contended that the Water Works should, under any circumstances, be constructed in the first instance by private enterprize, as it is to be presumed that capitalists embarking in such undertakings would bring to bear more special knowledge on the subject than could possibly be the

case with Local Authorities, inexperienced in works of the kind. But this is again replied to by the advocates on the other side that "supplies of water should be provided as a public service, and only at the expense of the service, and not for a trading profit on the necessities of the population."*

At the present time the subject possesses a peculiar interest in consequence of the announcement made by the Home Secretary in the House of Commons in the last session, that it is the intention of the Government to bring in a Bill during the present session (1880) for the transfer of the undertakings of the Water Companies at present supplying the Metropolis to a public authority. We shall have occasion to refer to this hereafter; but before doing so we propose to offer some remarks upon the general principles of compensation involved in the "transfer of water undertakings from private to public authorities."

At first sight it would appear that these transfers must take place either voluntarily on the part of the proprietors of the water works, or by compulsion under the powers of an Act of Parliament obtained for that purpose by the public authority desirous of purchasing. As a matter of practice, however, the former case may be dismissed from consideration here, as although such instances have occurred, and may do so again, they have been extremely rare, and are likely to become more so as the value of water works' property becomes daily more and more appreciated by investors.

On the other hand, sales by *compulsion* are still more rare, for Parliament is still most (and justly) conservative of the rights of those who have invested their capital on

* *Vide* Evidence of Mr. Robert Rawlinson, C.B., Chief Engineer of the Local Government Board, before the Special Committee of the Society of Arts, 1874.

the faith of the bargain by which, in consideration of their performing certain duties, which duties they have honestly performed, certain privileges have been granted to them. The result has been that, with one notable exception hereafter referred to, the majority of transfers have practically resolved themselves into matters of agreement between the parties, but from the sellers' point of view, an agreement tantamount to a sale by compulsion, and subject to compensation in respect of it.

Prior to the passing of the Stockton and Middlesbrough Corporations' Water Act of 1876, there was no specific instance of Parliament having required the direct compulsory sale of a water undertaking; the circumstances of that case were, however, altogether exceptional; in 1875 the Water Company applied to Parliament for powers to obtain an unlimited supply of water from the River Tees, but the Bill promoted with that object was rejected by Parliament mainly in consequence of the opposition of the Corporations to that source of supply; notwithstanding this, however, the Company brought in a Bill in 1876 which was practically identical with that which had been rejected in 1875, "an " indiscretion which they would have avoided had they " followed the advice of Mr. Hawksley,"* their engineer. The Corporations of Stockton and Middlesbrough promoted a Bill in the same year (1876) applying for power to bring in water from new sources and to purchase the Water Company's undertaking compulsorily, and although the Water Company then offered (through their Counsel) to pledge themselves, if the Corporations' Bill were rejected, to apply in the ensuing Session (1877) for an injunction to prevent the

* *Vide* "On the Compulsory Purchase of the Undertakings of Companies by Corporations." By J. H. Balfour Browne, Barrister-at-Law. Stevens & Haynes, 1877.

introduction into the river of any sewage which might pollute the water, and to construct a reservoir on the River Balder capable of supplying to the River Tees the same additional quantity as they might be by that Bill allowed to take from it, the Bill of the Water Company was rejected and that of the Corporations passed.

It affords, however, a very striking proof of the strong reluctance entertained by Parliament to require the compulsory sale of private undertakings established and carried on under their authority ; for, even under the circumstances above mentioned, the Water Company were successful in getting a clause introduced into the Act, whereby they became entitled to receive compensation, not only to the extent of 25 years' purchase of their maximum statutory dividend, but in addition, "a sum for compulsory sale and for the prospective value of the Company's undertaking."*

But while Parliament fully respects the rights of existing shareholders in Water Companies, there can be no doubt of its growing tendency to limit the profits on new capital very considerably as compared with those heretofore granted. By "The Water Works Clauses Act, 1847," the dividend on ordinary share capital was limited to 10 per cent. per annum, in the absence of any special limitation by the private Act ; and, although this is neither repealed nor likely to be, it has become the modern practice in the majority of new Acts for increase of capital to restrict the dividends on such new capital to 7 and even 6 per cent. per annum, while more recently what are known as "Auction Clauses" are inserted, the effect of which is, that in place of such additional capital being offered to the existing shareholders in proportion to their previous holdings of ordinary shares, it is made compulsory that the new capital shall be

* See page 42.

submitted to auction, and any premiums derived from it carried to the credit of the general capital account of the Company. The individual shareholder consequently has to be content with this indirect advantage, instead of receiving as formerly an allotment of the new capital, and profit by way of premium which it may have commanded in the market. This element of value, to which considerable importance has hitherto attached, may consequently be considered as fast disappearing.

In spite, however, of this important restriction the market value of water works property continues to improve, and shares which could a few years since command only from eighteen to twenty years' purchase of the dividend paid, now find ready buyers at a price to yield considerably less to an investor. The reason is not far to seek: it lies mainly in the fact that with rare exceptions the income of a Water Company is rapidly progressive, and that Parliament will not sanction the introduction of rival works, nor the purchase of works compulsorily, without full compensation being paid for existing interests: and that it is now recognized by investors that the revenues of Water Companies are not liable to be affected by new discoveries as is the case with Gas and other Companies. Add to this that many persons consider that it is only a question of a comparatively short time when every moderate sized community will be the owner of the local water works, adequate compensation being first paid to all Companies, and interests, which it will be necessary to buy up, and it need not be a surprise that water works' securities are so highly prized an investment at the present day.

But while it is fully admitted and perfectly equitable that not only the full value of the undertaking should be paid to the shareholders, but, except under very special circumstances, something in excess of it for compulsory purchase,

it equally behoves the purchasing authority to see that it is really and not merely superficially that they are obtaining money's worth for their money.

We propose, therefore, now to discuss the general basis on which such valuations should be made, premising, however, that in this respect no hard and fast line can be laid down, and that every case must stand upon its own particular merits or demerits, as the case may be.

The chief points to be examined and determined are:—

- (A) The authorized share capital of the Company, and statutory limitation of dividends in respect of each class of shares.
- (B) The amount of share capital still uncalled, and authorized dividend upon it.
- (C) The authorized loan capital of the Company, and amount issued.
- (D) The gross income.
- (E) The working expenses.
- (F) The net income.
- (G) The reserve or depreciation fund.
- (H) The prospective income.
- (I) The total annual amount of the maximum dividends authorized to be paid.
- (J) The rate and amount of dividends paid in every year from the commencement of the undertaking to the agreed date of transfer.
- (K) The outlay (if any) necessary to enable the existing income to be earned with certainty.
- (L) The outlay (if any) necessary to enable the prospective income to be earned with certainty.
- (M) Condition and capabilities of works and mains (in detail).

Although the particulars of the amount and division of the capital of the undertaking, Debenture Debt, &c., appear

first in order in the above list, we must at once explain that, although this information is necessary to the purchasers, *it ought not, in any way, to affect the calculation of the value of the undertaking.* It is not the business of the purchasing authority to inquire into whether the sellers will gain or lose by the transfer, but to see that they, as purchasers, will get value, present and prospective, for the money of those whom they represent. For the same reason it is desirable that the division of the proceeds of the sale amongst the various classes of Shareholders should be left to be arranged amongst their own body.

We now propose to offer a few remarks upon the above headings.

The *accounts* of the selling Company, for at least three years subsequent to the proposed purchase, should be submitted to independent examination by the purchasing authority, in order to see that the dividends paid are being fairly earned and paid out of revenue.

It is also important to analyze in detail how the *income* is made up, and whether it is of such a character as to justify the probability of its being maintained in the future.

As an illustration in point, the author was a few years since professionally engaged in the valuation of a water works for transfer, when inquiries similar to the above were instituted with very great advantage to the purchasers, for it appeared on investigation, that no less than half of the gross income was derived from two Railway Companies, and the serious contingency arose that those Companies might, at any time, construct works of their own, or dispense with the Company's supply. This was rightly considered a justification of the reduction of the number of year's purchase of the income of the Company.

In the same way the *expenditure* should not be calculated upon that of any particular year, but a fair

average taken of it, always bearing in mind that the expenditure should include all such items for repairs and renewals and such efficient maintenance of the works as will enable them to continue to earn the revenue. In the accounts this may either take the form of the cost of such renewals being debited to the revenue account of the particular year in which they are incurred, or of the establishment of a sinking fund to meet the average depreciation of the perishable portions of the works; the former is the custom which usually prevails in practice, but the latter is strictly speaking more equitable, and is the argument which the Water Companies invariably and rightly use in calculating for rating purposes the net rent which a hypothetical tenant would give for the concern.

The following is an illustration of the application of this latter principle in one of the instances already quoted :—

SINKING FUND OR DEPRECIATION ACCOUNT.

Description.	Total Cost.	Structural Cost of Perishable Portion.	Life. Year ^s	Annual Sinking Fund to replace £1 at end of Term, at 5 per Cent.	Total Amount of Annual Sinking Fund.	Number of Years of Life already Expired. ^s	Total Amount of Fund which should have been set aside for Depreciation.
Reservoir	£ 6,386	£ 1,000	60	.008	9 0 0	24	72 0 0
Tunnel	1,200	1,200	70	.002	2 8 0	24	57 12 0
Engine Station—							
(a) Engines and Pumps	9,083	8,300*	40	.008	23 8 0	20	448 0 0
		500*					
		<u>2,800</u>					
(b) Boilers, with Seating, &c.	1,000	480	30	.016	6 0 0	24	144 0 0
		50†					
		<u>400</u>					
(c) Buildings	4,050	2,550	70	.002	5 2 0	24	122 8 0
(d) Cottages	250	250	90	.001	2 1 0	24	49 4 0
(e) Filters and Works .	1,250	1,250	60	.003	8 15 0	24	90 0 0
Service Reservoir . . .	1,948	1,000	60	.003	3 0 0	24	72 0 0
Mains and Iron Services .	9,409	9,409	70	.005	45 0 0	20	900 0 0
		Say 409†	20§				
		<u>9,000</u>	<u>50</u>				

* Value at end of Term.

† Value of old iron.

‡ Less value of old iron.

§ Incurstion.

Note.—The length of life opposite each of the above items is only to be considered as applicable to the particular instance referred to : it varies considerably in different cases.

In connection with the expenditure it is also essential to ascertain whether the Water Works are contributing their legal quota of taxes, or whether they are liable to increased (or possibly decreased) assessment; having regard to what we have already stated upon this subject,* the importance of this question is, to both vendor and purchaser, strikingly apparent.

Intimately connected also with this question is that of *the condition and capabilities of the works at the time of the transfer*, which must, necessarily, form a vital element in the purchasers' calculations, as the value of the undertaking depends in a great measure upon their efficiency and capability to continue to earn the income.

This point necessarily involves considerations of the source of the water supply, more especially as regards its quantity and quality, the adequacy of the works to distribute this quantity at the necessary pressure, the condition of reservoirs, filters, engines, mains, meters, and many other matters of a similar character.

One of the most important of the above items is that relative to the mains, the condition of many of which is frequently a source of serious expense in old-established water works which were constructed when pipes were not subjected to the "coating" process, invented by Dr. Angus Smith, which has the effect of preserving them both internally and externally.† In one case where the author was concerned, this formed a very serious element in the calculations of value, for upon investigation it was ascertained that several of the mains had become choked with a deposit of peroxide of iron, which had the effect of seriously restricting their carrying capacity; in the case referred to an outlay sufficient to reimburse the expense of replacing the defective pipes was very properly claimed on behalf of the purchasers.

* See pages 19 and 20.

† This "coating" is not invariably required, the constituents of the water and the soil in which the pipes are laid necessitating it or otherwise.

In considering the *capabilities* of the works, regard must be had not only as to their sufficiency to meet the ordinary requirements of the district to be supplied, but it is also important to ascertain whether proper provision has been made in the way of reserve works, so as to ensure the supply of water being properly maintained in case of accident to any part of the works, which, from a purchaser's point of view, he has clearly a right to expect; on the other hand, if it should happen that after making provision for adequately carrying on the works and guarding against contingencies, there should still remain a surplus of engine or other power, such surplus works should be considered in the light of provision made towards earning increased revenue, and should be taken into consideration by the vendors as a credit from any outlay which would be necessary to enable an increased income to be earned.

The *prospective income* should obviously form a most important element in the calculations for compensations, for not only does it involve the question of the maintenance or possible *diminution* of the existing income, but also that of the *increase* which, with remarkably few exceptions, takes place in the revenue derivable from water receipts year by year. Upon this question the assistance of local experts and vital statisticians should be invoked, in order to arrive at a proper conclusion upon the special circumstances of the case under consideration. *The question also of any additional outlay of capital being required to earn any increased income must be well considered, and careful estimates made of the cost and maintenance of such new works as will be necessary.* As an illustration of this, the following Table (prepared by the Author, and handed in during his evidence in the case of the transfer of the undertakings of the Stockton and Middlesbrough Water Company to the joint Corporations) may be of service.

Table of Prospective Value, based on the assumption that the Water Company had obtained an Act of Parliament in 1877 to carry out Mr. Mansergh's scheme, but excluding the works in the Lune Valley, and limiting the outlay to £500,000 for new works, plus £50,000 for distributory mains.

YEARS.		Profit remaining after deducting present Statutory Dividend.	New Capital, Four-fifth Share, One-fifth Loan.	Annual Cost of Capital, Four-fifths at 5 per Cent., One-fifth at 4 per Cent.	Surplus Profit.	Deficit.
	1877	£6,474				
1	1878	£ 8,694	100,000	£ 4,800	£ 3,894	£
2	1879	10,914	220,000	10,560	354	
3	1880	10,914	340,000	16,320		5,406
4	1881	10,914	460,000	22,080		11,166
5	1882	10,914	580,000	27,840		16,926
6	1883	15,354 1,700*	585,000	28,080		11,026
7	1884	19,254	590,000	28,320		9,066
8	1885	21,454	595,000	28,560		7,106
9	1886	23,654	600,000	28,800		5,146
10	1887	25,854	605,000	29,040		3,186
11	1888	28,054	610,000	29,280		1,226
12	1889	30,254	615,000	29,520	734	
13	1890	32,454	620,000	29,760	2,694	
14	1891	34,654	625,000	30,000	4,654	
15	1892	36,854	650,000	30,240	6,614	
					18,944	70,254
						18,944
					Deficit..	51,310

* Saving in pumping expenses.

The question of the *dividends* paid in every year by the selling Company from the time of its foundation until the date of the transfer is important, because, as already mentioned, in the majority of instances the water works were constructed many years ago, before their importance and usefulness were appreciated as at the present day, and it has consequently happened that, during the early years of the Company's existence, the shareholders have either not received any dividend at all, or something considerably below that sanctioned by Parliament; this contingency was not unforeseen by the framers of "The Water Works Clauses Act, 1847," for it is therein provided that "the profits of the undertaking to be divided among the undertakers in any year shall not exceed the prescribed rate, or where no rate is prescribed they shall not exceed the rate of ten pounds in the hundred by the year on the paid-up capital of the undertaking which in such case shall be deemed the prescribed rate, unless a larger dividend be at any time necessary to make up the deficiency of any previous dividend which shall have fallen short of the said yearly rate."

As an illustration of the above we extract the following from a pamphlet published in 1849 by the Chairman, at that time, of two of the Metropolitan Water Companies.*

"The New River Company is divided into 72 shares, on each of which the capital expended was, in 1828, £14,400. "The average dividend for 10 years from 1800 was £455 "per annum, for 10 years from 1810, £173 per annum, "and during the years 1813, 1814, 1815, and 1816 respectively, £125, £25, £63, and £85.

"The West Middlesex Company, established in 1807, was for 12 years, namely to 1819, without any dividend at all.

* "Remarks on the Water Supply of London," by Sir William Clay, Bart., M.P.

" The Grand Junction Company, established in 1809, was " for 10 years, to 1819, equally without dividend.

" The Chelsea Company did not diminish their dividend, " but they were only paying altogether £2,400 per annum " to their proprietors. During the century that had elapsed " from their foundation to 1820, they had been 30 years " without any dividend."

It is therefore manifestly fair that the shareholders should receive compensation for the arrears of former dividends, if it can be proved that they would be receiving them if they continued to hold the property, but the amount of any such compensation must of course be dependent upon the special circumstances of each case.

Assuming the necessary data to enable the items above enumerated (with such additional details as the special case may require) to have been ascertained, the purchase money should consist of :—

- (A) Compensation in respect of present net income.
- (B) Compensation in respect of future additions to net income.
- (C) Compensation in respect of arrears of former dividends.
- (D) Compensation in respect of surplus works and property.
- (E) Compensation in respect of Capital authorized but unissued.
- (F) Compensation in respect of compulsory sale.

These items should be respectively dealt with as follows :—

- (A) } Capitalized at present value.
- (D) }
- (B) } Capitalized at present value of the deferred values
 (c) } or reversionary interests at the respective periods
- (C) } when the Shareholders would have been in
 (E) } receipt of them.

The last item, compulsory sale, is one in respect of which it is well established that, unless under very special circumstances, compensation should be paid, and the amount of such compensation is usually valued by experts at 10 per cent. upon the selling price of the undertaking.

In addition to the above, the purchaser would have to take a transfer of and be liable for the authorized debentures or loan capital expended by the Water Company, the interest upon which has been previously debited to the revenue account in diminution of the net profits of the undertaking.

The aggregate amount of the above should be the sum to be paid to the Water Company, less the present value of any outlay which may be proved to be necessary to put the works in a position to enable them to earn the present and prospective income, and less also the amount of the reserve fund, which may have become necessary to replace any parts of the works requiring renewal.

It is extremely important here to observe the growing tendency of Corporations to pay, and arbitrators to award, more compensation than formerly for this class of property; thus, if we take the following examples, we shall see how prices have gradually increased. Of course there have been special circumstances in each case, but not sufficient to account for the steady increase in the number of years' purchase awarded, except the increased appreciation of Water Works as an unopposed and safe investment.

In 1868 an agreement was made between the Brighton, Hove, and Preston Water Works Company and the Brighton Corporation, whereby the latter acquired the Water Works undertaking at the price of 20 years' purchase of the maximum dividend which the Company was entitled to earn, which was equivalent to $22\frac{1}{2}$ years' purchase of the then existing dividend.

In 1872 the sale price of the Aberdare Water Works to the Local Board of Health was fixed by Arbitration at 22 years' purchase of the net revenue.

In the same year the undertaking of the Lincoln Water Works was sold to the Corporation at 23½ years' purchase of the net revenue; the price in this case was also determined by Arbitration.

In 1875 the Corporation of Birmingham purchased by agreement the undertaking of the Birmingham Water Company upon the following basis:—

	£	£
Largest realized profit	47,712	
1. Maximum statutory dividend on called-up capital, although not realized, viz. :—		
(a) 8 per cent. on £420,000 .	83,600	
(b) 7 per cent. on £252,000 .	17,640	
	————	51,240
2. Allowance for possible future profits on £84,000 not called up. Present value of deferred interest, calculated at 3 per cent. thereon		2,376
3. Allowance in respect of Shareholders' interest in arrears of dividend amounting to £52,520, which may hereafter become payable, if and when the Company's profits shall become sufficient for that purpose, present value estimated at one-half the amount of arrears, and converted into perpetual annuities at 4 per cent. saleable at 25 years' purchase		875
	————	
		£54,491

The Corporation agreed to pay on the above footing perpetual annuities secured on the Waterworks Income, and all rates of the town, and property of the Corporation . £54,491

Estimated at the saleable value of 25 years' purchase, or amounting on the whole to $\text{£54,491} \times 25$ 1,362,275

4. And to this was added, for winding-up purposes, the sum of 3,022

Making a total of £1,365,297

Being $\frac{1,365,297}{47,712} = 28\frac{6}{17}$ years' purchase on the largest realized dividend of the Company.

5. Besides this the Corporation took over all the mortgages of the Company, and all its debts and liabilities.

In 1876 the Stockton and Middlesbrough Joint Corporations obtained (under the circumstances already referred to, page 28) an Act of Parliament for the compulsory acquisition of the undertaking of the Water Company supplying those districts; by a clause in the Act the Corporation were required in addition to the payment of 25 years' purchase of the maximum statutory dividend of £18,647 per annum, and the taking over the statutory debt of the Company at the time of the transfer, to pay "a sum for compulsory sale and for the prospective value of the Company's undertaking," which resulted in a sum of £213,802 being awarded in respect of these latter items, making the total purchase money (exclusive of the statutory debt) equivalent to $36\frac{1}{17}$ years purchase of the maximum authorized dividend of the Water Company.

In 1878 the Bangor Water Works were acquired by the Local Board of Health in consideration of their granting to the Water Company's Shareholders perpetual annuities at the rate of 10 per cent. on the capital.

In the same year the Corporation of Leicester acquired the Water Works supplying that town in consideration of guaranteeing 7 per cent. per annum on the share capital of the Company, but it is to be noted that in this case the Corporation were already largely interested in the Water Company, having originally subscribed for a considerable portion of the share capital, which entitled them not only to dividend, but to one moiety of the net profits above £4 10s. per cent.

In 1879 the Cardiff Water Works were sold by agreement to the Corporation at 25 years' purchase.

In the same year the Colchester Water Works were sold to the Local Authorities by agreement at 27½ years' purchase.

But the results in the above cases do not represent the whole difference or *excess* paid in these latter times as compared with even a few years ago.

It must be remembered that whenever new works are required, and additional capital has to be provided, the money has to be raised at a much higher rate than would be the case if it were borrowed by a public body ; even assuming the auction clauses already referred to (page 29) to be inserted in the Water Companies' Acts, there must always be a considerable margin in favour of dividends on capital raised by shares, as compared with the interest to be paid out of and secured by public rates ; and in the event of a purchase by the public authorities, this excess has to be capitalized ; this is but equitable and just to the Water Companies' shareholders, but a corresponding disadvantage to the ratepayers.

Probably the best illustration of this disadvantage is to be found in the case of the Water Companies supplying the Metropolis.

	£
In 1849 their united share capital raised was -	2,308,000
And it has been estimated by competent authorities that they could at that time have been purchased for - - - - -	6,000,000
Since that period the new share capital raised has amounted (to the end of 1878) to - - - - -	7,401,421
And the amount of net revenue, applicable to dividend for the year 1878, was - - - - -	741,646

Now, had the Water Companies been purchased by a public authority in 1849, at the price of £6,000,000, this new capital could have been raised at $3\frac{1}{2}$ per cent. per annum, the consequence of which would have been a saving to the ratepayers, after payment of interest on the purchase money, of no less than £272,596 per annum, from the difference in the amount of interest paid to shareholders and that at which the new capital could have been borrowed by a public authority. This amount is quite independent of the saving in capital outlay which would have been effected by the construction of united instead of separate works, and in the expense of administration under unity of management, which latter would probably have amounted to at least £100,000 per annum, nor has any credit been taken for the reduced rate at which the preference and additional debenture capital, created since 1849, could have been raised or the old reborrowed as paid off.

Calculations on a basis similar to the above were at that time furnished by Mr. Quick, C.E.,* to the Chairman of the Southwark and Vauxhall and Grand Junction Water Companies,† and submitted by him to Mr. Edwin Chadwick, C.B., of the General Board of Health; and, had

* The Author's father.

† Sir William Clay, Bart., M.P.

Y.

in future, if not Purchased by a Public Authority.

12	13	14	15	16	17
Dividends Preference Capital.	Interest on Debenture Debt (average, 4½ per Cent.)	Balance remaining, less Dividend on Ordinary Share Capital, with maximum Dividend of 10 per Cent. (Column 2).	Rate per Cent. of Dividend on Ordinary Share Capital, entitled to maximum Dividend of 10 per Cent. (Column 2).	Amount of Dividend on Ordinary Share Capital, entitled to maximum Dividend of 10 per Cent. (Column 2).	Balance remaining towards payment of arrears of Dividends.
£	£	£		£	£
2,820 (actual)	99,808 (actual)	653,824	7·95	822,226	—
2,820	102,451	673,839	8·19	822,226	—
2,820	104,576	696,218	8·47	822,226	—
2,820	106,701	719,998	8·76	822,226	—
2,820	108,826	745,284	9·06	822,226	—
2,820	110,951	771,984	9·39	822,226	—
2,820	113,076	800,809	9·73	822,226	—
2,820	115,201	830,272	10·00	822,226	8,046
2,820	117,326	861,941	10·00	822,226	39,715
2,820	119,451	895,877	10·00	822,226	73,151
2,820	121,576	930,658	10·00	822,226	108,432
2,820	123,701	967,855	10·00	822,226	145,629
2,820	125,826	1,007,046	10·00	822,226	184,820
2,820	127,951	1,048,809	10·00	822,226	226,083
2,820	130,076	1,091,727	10·00	822,226	269,501
2,820	132,201	1,137,387	10·00	822,226	315,161

onths of this sum will be raised by Share Capital, entitled to a
per cent. per annum.

HERS & Co., 14, George Street, Mansion House, E.C.



the policy then advocated been carried into effect, it would have resulted, as will be seen by the above figures, *in a reduction of the water rates payable by the inhabitants of the metropolis to no less than £372,596 per annum, or twenty-six and a half per cent. of the water rates at present levied upon them, and this independently of the saving in capital outlay which would have resulted from the construction of united instead of separate works.*

The annexed Table, page 45, which has been carefully prepared, and checked by an eminent firm of accountants, shows what would be the financial result of a continuance of the water administration of the Metropolis in the hands of the Water Companies, for a period of 14 years from the present time.

An examination of this Table shows that, in the 15 years from 1878 that will elapse before the Companies are in the enjoyment of their maximum statutable dividends, and the payment on account of arrears of dividends to the extent shewn in column 17, and on the assumption that the outlay for new works during that period, will amount to £3,000,000, the net increase of annual revenue will be £673,956, *the whole of which, with the exception of £32,393, the increased amount of interest on Debentures, or a net amount of £641,563 will be applicable to the payment of increased dividends and arrears of former dividends on the Share Capital of the Water Companies.*

Applying the same illustration, and adopting the same general basis of calculation, as in the case of the interval from 1849 to 1878, we find that the saving in the year 1893, assuming the capital for the new works to be issued by a public authority, will amount to no less than £757,116 per annum!!! as will be seen from the following figures, *viz.* :—

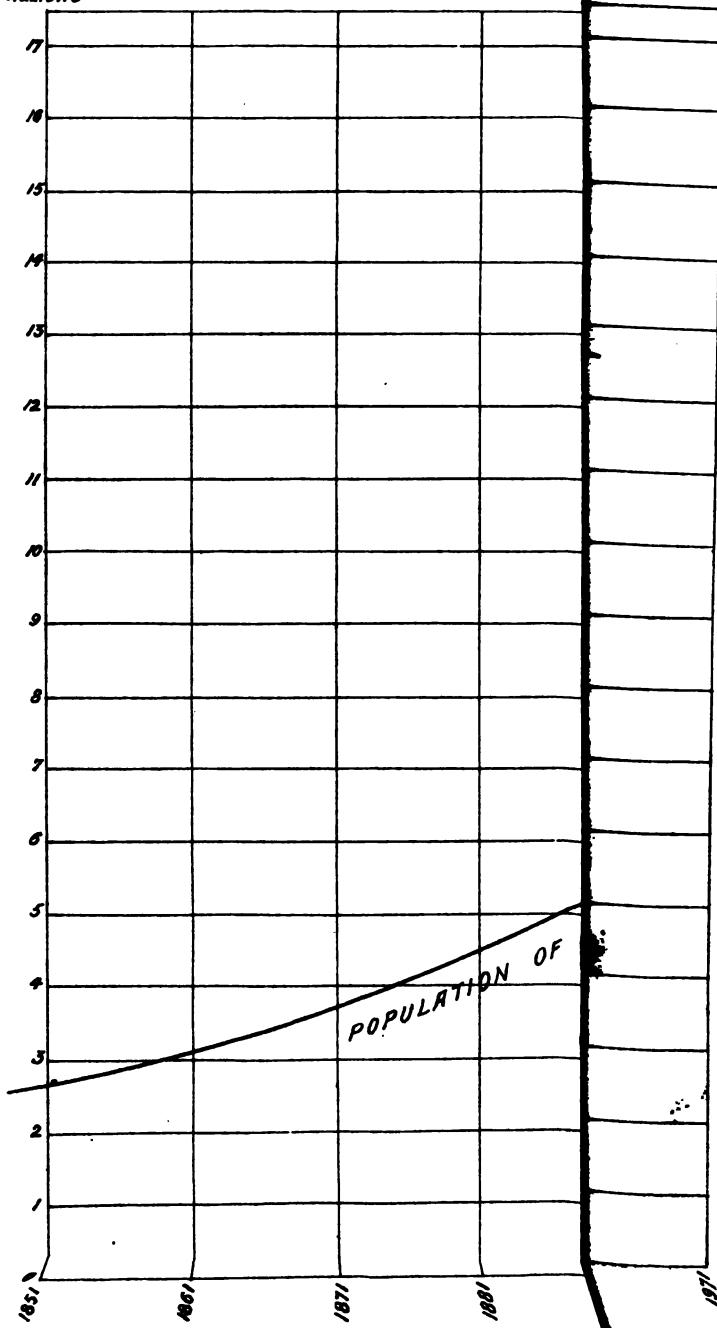
Year 1893—	£	£
Net Revenue (estimated) .	1,515,410	
Less Interest and Sinking		
Fund on present Debenture Capital, and estimated outlay for new works	116,648	
Net available Balance .	—	1,398,762
 Year 1878—		
Net Revenue	841,454	
Less Interest on Debenture Capital	99,808	
	—	741,646
	—	657,116
Saving in Annual Working Expenses under unity of Management .	100,000	
	—	
Net Annual Surplus Revenue remaining in 1893	£757,116	
	—	

In estimating the economies to be derived from the consolidation of works and unity of management at £100,000 per annum,* we believe we are within the mark, for this saving would undoubtedly be increased year by year, and thus add materially to the ultimate financial gain, of which the Metropolitan ratepayers would derive the benefit. Although these results are of so startling a character, they are arrived at by adopting, as the basis of

* See confirmatory evidence upon this point by Mr. Rawlinson, C.E., and Mr. Quick, C.E., before the Special Committee of the Society of Arts, 1874.

DIAGRAM 5.
OF THE POPU

MILLIONS



calculation, the lowest ratio of progress which has actually occurred since 1856, as will be seen by the following figures :—

Year.	Net Revenue of the Companies.	Increase per Cent. per Annum.
	£	
1856	303,234	
1866	498,234	5·09
1873	657,922	4·05
1878	841,454	5·05
1893 (estimated) . .	1,515,410	4·00

The financial gain to the public by the transfer of the London Water Companies to a public authority, even after allowing compensation on the most liberal basis to the Shareholders in these undertakings is therefore, beyond question, and it is impossible to exaggerate the importance of immediate action being taken in the matter in the interests of the Ratepayers.

The annexed Table and Diagram (page 48) prepared several years ago by an eminent Surveyor* for a purpose in no way connected with the subject of which we are treating, exhibit in a striking degree the enormous increase which may be expected to take place in the population of London, and that the basis of calculation which he then adopted is strictly reliable may be seen by a comparison of the actual population of London in 1871 and at the present time with that anticipated by the Table. These results afford strong corroborative evidence that our estimates of the probable increase in the revenue from Water Rates in future years are by no means excessive.

* Mr. Ryde, by whose courtesy we are enabled to insert the Table and Diagram.

*Estimated Population of London within the Metropolitan and
City Police Division.*

1851	(actual)	2,680,735
1861	(actual)	3,222,720
1871		3,883,092
1881		4,678,800
1891		5,637,600
1901		6,793,000
1911		8,184,900
1921		9,862,200
1931		11,883,000
1941		14,318,000
1951		17,252,000

There are many other matters in connection with this important subject, which we cannot enter upon here, *e.g.*, the question of superannuation of Officers and Directors and compensation for allotments of unissued capital, which would have commanded a premium (in cases where the auction clauses have not yet been introduced) at the time of transfer, mode of dealing with surplus land and estates, &c., &c.

We may, however, mention that with regard to the compensation to the Officers and Directors of existing Companies there are already many precedents for the former, the principle being thoroughly established that they are entitled to full compensation by way of superannuation in proportion to the length of their services, but with regard to the Directors the question is still an open one; there appears to us, however, to be no valid reason why Directors should not be entitled to be compensated for their loss of office, for it must be remembered that in estimating the net profits to arrive at the saleable value

of the concern the revenue has already been debited with their remuneration as a current charge, and therefore the purchasers are receiving the full benefit of the future annual saving in this respect. Even if objection be taken to this on the ground that the Directors are only elected for limited periods, the amount of their remuneration should (except in cases where the maximum dividend is being paid and the Shareholders have received all arrears of dividend from former years) be added to the net profits of the concern, capitalized, and paid for by the purchasers, leaving the shareholders to grant such sum out of this to the Directors as may be agreed.

With regard, however, to these and other similar matters, no specific rule can be laid down, but each case must stand upon its own merits, for it will be readily understood that hardly a single case of transfer arises in practice without having some exceptional or local circumstances in connection with it requiring special consideration and treatment; nor have we thought it desirable, within the limits of this pamphlet, to deal with the advantages of a public supply of water from a sanitary point of view, as these have already formed the subject of repeated and exhaustive examination by competent authorities elsewhere. We trust, however, that we have said enough to indicate and draw attention to the leading points which should be borne in mind in arriving at a general basis which will be equitable for both the shareholders in **Water Undertakings** and the ratepayers at large.



ADDENDUM.

**PROPOSED PURCHASE OF THE METROPOLITAN WATER
COMPANIES BY THE GOVERNMENT.**

On the eve of the issue of the preceding remarks, the Home Secretary has introduced the promised measure for the purchase of the Metropolitan Water Companies by a Public Trust to be created for the purpose. It appears from the Schedule attached to the Bill which is now before us that it is proposed to acquire the undertakings of the eight London Water Companies by a payment to the Shareholders of "Water Stock," bearing $3\frac{1}{2}$ per cent. interest, and that provisional agreements have been made with the various Companies, whereby they have consented to accept this Water Stock in lieu of any money payment. This mode of arrangement has certainly the merit of simplifying the raising of the necessarily large amount of purchase-money; but what it is more important to examine is whether the *amount* of the Water Stock proposed to be paid to the Water Companies is fair and reasonable as between them and the public.

As we have already stated (page 32), “It is “not the business of the purchasing authority “to inquire into whether the sellers would gain “or lose by the transfer, but to see that they, as “purchasers, will get value, present and pro-“spective, for the money of those whom they “represent.” We propose now, therefore, to consider the question of whether the Government have made a wise bargain on behalf of the public, or have been too lavish in the sums which they have consented, subject to the approval of Parliament, to pay to the Water Companies.

It is proposed by the Bill to create two classes of Water Stock, viz., “Original” and “Deferred,” the former being entitled to interest from the date of its issue, and the latter to merge into “Original” stock at periods varying from one to twelve years hence, but carrying no interest until it does so. What it is, therefore, essential to ascertain is, whether the income derivable from the water-rates will be sufficient to meet the interest on the “Original” Water Stock and the “Deferred” Stock as it becomes entitled to interest, any deficiency in this respect being a disadvantage to the Ratepayers, or *vice versa*. In connection with this, also, it is important not to lose sight of the outlay which will be necessary for new works, which must, as in the calculations in the table (page 44), be taken into consideration, but with this difference,

that the estimated outlay, within the next thirteen years, of £2,600,000 for new works and mains which would be required if the Companies are to continue, will be reduced by at least one-half of that amount by consolidation of works, and that the saving of £100,000 per annum* by unity of management, which we have already alluded to (page 46), will also come into operation. Upon these data we have based the following table:—

* As it cannot be expected that the whole of this economy will take place *immediately*, credit has only been taken for its being effected *gradually*. The economy in one item alone—viz., Directors' remuneration—will be nearly £15,000 per annum, the present cost being £20,810; whereas, by the Government Bill, the total salaries to be paid to the Board of Administration will amount to £5,600 only.

METROPOLIS WATER SUPPLY.

TABLE SHOWING FINANCIAL RESULTS OF THE PURCHASE OF THE METROPOLITAN WATER COMPANIES UPON THE TERMS PROPOSED IN THE GOVERNMENT BILL, 1880.

Year.	Amount of Water Stock entitled to Interest, including an Average Expenditure of £100,000 per annum on new Works.	£	Amount of Interest on Water Stock at $\frac{3}{4}$ per cent.	£	Estimated Gross Revenue from Water Rates (as per Table, page 44).	Estimated Working Expenses (as per Table, page 44).	£	FINANCIAL RESULT.	
								Estimated Net Revenue, applicable to payment of Interest on Water Stock.*	Deficiency.
1880	22,098,700	773,454		1,476,100	565,984	768,872	4,682		
1881	22,895,450	801,341		1,518,002	566,481	805,277			3,936
1882	24,037,200	841,302		1,550,827	566,445	843,138			1,836
1883	24,847,950	869,678		1,589,597	565,840	882,513			13,885
1884	26,165,700	915,799		1,629,336	564,629	923,463			7,664
1885	26,904,700	941,665		1,670,069	562,74	966,061			24,386
1886	28,204,700	987,165		1,711,820	560,283	1,010,343			23,178
1887	29,185,700	1,021,500		1,754,615	556,965	1,068,557			41,057
1888	30,145,700	1,055,100		1,798,480	552,924	1,110,463			55,363
1889	30,937,700	1,082,820		1,843,442	548,064	1,160,285			77,465
1890	31,817,700	1,113,620		1,889,528	542,334	1,212,101			98,481
1891	32,204,700	1,127,165		1,936,766	535,684	1,265,989			188,824
1892	32,598,700	1,140,955		1,985,185	528,060	1,323,032			181,077

Net Surplus Income in 1892.....

£181,077.

* After payment of Interest on present Preference Shares and Debentures.

From the above table it is evident that notwithstanding what appears to be at first sight the high price which the Government propose to pay to the Water Companies, in reality they have practically secured to the Ratepayers, *without any payment whatever*, and after making provision for outlay on new works* the reversion to a net income of £181,077 per annum, in twelve years' time, representing, at present value, a sum of upwards of £3,500,000 sterling, and this without taking into account the reversion to the increased income which will accrue year by year after 1892, or the accumulated surplus income prior to that year, which latter will amount to upwards of £600,000. While, therefore, on the one hand, the Shareholders in the Water Companies will have reason to be satisfied with the arrangements made, no injustice will be done to the Ratepayers, who will, on the contrary, reap a considerable pecuniary advantage. Looking at the matter impartially, this conclusion appears to us to be unavoidable, and we think, moreover, that the Government have acted wisely in coming to terms with the Water Companies, instead of resorting to Arbitration, which must,

* In the Table, no credit has been taken for the saleable value of certain of the works, which it is within our personal and professional knowledge, can be dispensed with by consolidation.

in any case, have involved an enormous expense and, in all probability, would have resulted in the Companies obtaining the extreme value of their property, instead of any margin being left for the benefit of the community, as will now be the case.

Without entering into other questions involved in the Bill, *e.g.*, the composition of the Trust, &c., we may safely affirm that from an economic point of view the inhabitants of the Metropolis and its suburbs will, if the Bill becomes law, have every reason to be satisfied with the result.

J. Q., J^R

WESTMINSTER,

March 8th, 1880.

LONDON:

E. & F. N. SPON, 46, CHARING CROSS.

NEW YORK:

446, BROOME STREET.

1880.

BOOKS RELATING
TO
APPLIED SCIENCE,
PUBLISHED BY
E. & F. N. SPON,
LONDON: 46, CHARING CROSS.
NEW YORK: 446, BROOME STREET.

The Ornamental Penman's, Engraver's, Sign Writer's, and Stone Cutter's Pocket-Book of Alphabets; including Church Text, Egyptian, Egyptian Perspective, French, French Antique, French Renaissance, German Text, Italic, Italian Shaded, Italian Hair Line, Monograms, Old English, Old Roman, Open Roman, Open Stone, Ornamental Roman, Latin, Rustic, Tuscan, etc. Fcap. 8vo, sewn, 6d.

Algebra Self-Taught. By W. P. HIGGS, M.A., D.Sc., LL.D., Assoc. Inst. C.E., Author of 'A Handbook of the Differential Calculus,' etc. Crown 8vo, cloth, 2s. 6d.

CONTENTS :

Symbols and the Signs of Operation—The Equation and the Unknown Quantity—Positive and Negative Quantities—Multiplication—Involution—Exponents—Negative Exponents—Roots, and the Use of Exponents as Logarithms—Logarithms—Tables of Logarithms and Proportionate Parts—Transformation of System of Logarithms—Common Uses of Common Logarithms—Compound Multiplication and the Binomial Theorem—Division, Fractions and Ratio—Continued Proportion—The Series and the Summation of the Series—Limit of Series—Square and Cube Roots—Equations—List of Formulae, etc.

Progressive Lessons in Applied Science. By EDWARD SANG, F.R.S.E. Crown 8vo, cloth, each Part, 3s.

Part 1. Geometry on Paper—Part 2. Solidity, Weight, and Pressure—Part 3. Trigonometry, Vision, and Surveying Instruments.

On Designing Belt Gearing. By E. J. COWLING; WELCH, Mem. Inst. Mech. Engineers, Author of 'Designing Valve Gearing.' Fcap. 8vo, sewed, 6d.

Arbitrations: a Text-book for Surveyors in Tabulated form. By BANISTER FLETCHER, F.R.I.B.A., Author of 'Model Houses,' etc. Crown 8vo, cloth, 5s.'

CONTENTS :

What matters may be submitted to Arbitration—Of the Submission—Of Revocation—Who may Arbitrate—Powers of the Arbitrators—Of Joint Arbitrators and Umpires—Of Evidence—Of the Award—Of Costs and Charges—Advice to Plaintiffs and Defendants—Appendix of Forms.

A Handbook of Formulae, Tables, and Memoranda, for Architectural Surveyors and others engaged in Building. By J. T. HURST, C.E. Twelfth edition, thoroughly revised and re-written. Royal 32mo, roan, 5s. CONTAINING :

Formulae and Tables for the Strength of Materials, Roofs, Water Supply, Drainage, Gas, and other matters useful to Architects and Builders—Information connected with Sanitary Engineering—Memoranda on the several Trades used in Building, including a Description of Materials and Analyses for Prices of Builders' Work—The Practice of Builders' Measurement—Mensuration and the Division of Land—Tables of the Weights of Iron and other Building Materials—Constants of Labour—Valuation of Property—Summary of the Practice in Dilapidations—Scale of Professional Charges for Architects and Surveyors—Tables of English and French Weights and Measures.

"It is no disparagement to the many excellent publications we refer to, to say that in our opinion this little pocket-book of Hurst's is the very best of them all, without any exception. It would be useless to attempt a recapitulation of the contents, for it appears to contain almost *everything* that anyone connected with building could require, and, best of all, made up in a compact form for carrying in the pocket, measuring only 5 in. by 3 in., and about $\frac{1}{4}$ in. thick, in a limp cover. We congratulate the author on the success of his laborious and practically compiled little book, which has received unqualified and deserved praise from every professional person to whom we have shown it."—*The Dublin Builder.*

A Treatise on the Use of Belting for the Transmission of Power; with numerous Illustrations of approved and actual methods of arranging Main Driving and Quarter-Twist Belts, and of Belt Fastenings. Examples and Rules in great number for Exhibiting and Calculating the Size and Driving Power of Belts. Plain, Particular, and Practical Directions for the Treatment, Care, and Management of Belts. Descriptions of many varieties of Beltings, together with chapters on the Transmission of Power by Ropes; by Iron and Wood Frictional Gearing; on the Strength of Belting Leather; and on the Experimental Investigations of Morin, Briggs, and others for determining the Friction of Belts under different Tensions, which are presented clearly and fully, with the Text and Tables unabridged. By JOHN H. COOPER, M.E. 1 vol., demy 8vo, cloth, 15s.

Researches on the Action of the Blast Furnace. By CHARLES SCHINZ. Translated from the German by W. H. Maw and Moritz Müller. Plates, crown 8vo, cloth, 8s. 6d.

Spons' Builders' Pocket-Book of Prices and Memoranda. Edited by W. YOUNG, Architect. Royal 32mo, roan, 4s. 6d.; or cloth, red edges, 3s. 6d. Published annually. Sixth edition now ready.

Long-Span Railway Bridges, comprising Investigations of the Comparative Theoretical and Practical Advantages of the various adopted or proposed Type Systems of Construction, with numerous Formulae and Tables giving the weight of Iron or Steel required in Bridges from 300 feet to the limiting Spans; to which are added similar Investigations and Tables relating to Short-span Railway Bridges. Second and revised edition. By B. BAKER, Assoc. Inst. C.E. *Plates*, crown 8vo, cloth, 5s.

The Builder's Clerk; a Guide to the Management of a Builder's Business. By THOMAS BALES. Fcap. 8vo, cloth, 1s. 6d.

The Cabinet Maker; being a Collection of the most approved Designs in the Mediæval, Louis-Seize, and Old-English styles, for the use of Cabinet Makers, Carvers, etc. By R. CHARLES. 96 *plates*, folio, half-bound, 21s.

The Elementary Principles of Carpentry. By THOMAS TREDGOLD. Revised from the original edition, and partly re-written, by JOHN THOMAS HURST. Contained in 517 pages of letter-press, and illustrated with 48 *plates* and 150 *wood engravings*. Second edition, crown 8vo, cloth, 18s.

Section I. On the Equality and Distribution of Forces—Section II. Resistance of Timber—Section III. Construction of Floors—Section IV. Construction of Roofs—Section V. Construction of Domes and Cupolas—Section VI. Construction of Partitions—Section VII. Scaffolds, Staging, and Gantries—Section VIII. Construction of Centres for Bridges—Section IX. Cofferdams, Shoring, and Strutting—Section X. Wooden Bridges and Viaducts—Section XI. Joints, Straps, and other Fastenings—Section XII. Timber.

"A considerable time having elapsed since the publication of the second edition of this work, which was the last that had been revised by the author, his death occurring soon after, a new edition that would embrace recent improvements and examples was much required. Our stock of knowledge regarding the strength of materials has been largely increased, owing to the labours of Hodgkinson, Kirkaldy, and others. The rapid development of the railway system throughout the world has contributed greatly to the introduction of new methods and to the multiplication of examples in the art of construction. More perfect and scientific appliances in the erection of large works have been substituted for the primitive methods used in the last generation. These have all tended more or less to tax the ability and knowledge of the carpenter. The opening up and development of the resources of new countries have introduced varieties of timber, many of them possessing useful properties, not the least of which is that of resisting the attack of sea-worms and insects—a cause of destruction that has hitherto been a source of much anxiety to the Profession.

"In order to adapt this work as far as possible to the requirements of the modern carpenter, it has been necessary to re-write the articles on Pillars, Bridges, and Timber; to add new sections on Cofferdams, Scaffolds, etc., and to revise the remainder of the work throughout. And for the more complete illustration of these subjects several new plates and woodcuts have been added.

"The Editor trusts that this edition will merit the confidence of the Profession as a book of reference, and afford at the same time valuable assistance to the student."

Engineering Notes. By FRANK ROBERTSON, Fellow Roy. Astron. Soc., late first Lieut. R.E., and Civil Engineer Public Works Department in India. 8vo, cloth, 12s. 6d.

The object of this work is to supply an exhaustive digest of all that is known on each subject, so far as is necessary and sufficient for an Engineer in practice, especially in India.

A Practical Treatise on Casting and Founding, including descriptions of the modern machinery employed in the art. By N. E. SPRETSON, Engineer. With 82 plates drawn to scale, 412 pp. Demy 8vo, cloth, 18s.

A Pocket-Book for Chemists, Chemical Manufacturers, Metallurgists, Dyers, Distillers, Brewers, Sugar Refiners, Photographers, Students, etc., etc. By THOMAS BAYLEY, Assoc. R.C. Sc. Ireland, Analytical and Consulting Chemist, Demonstrator of Practical Chemistry, Analysis, and Assaying, in the Mining School, Bristol. Royal 32mo, roan, gilt edges, 5s.

SYNOPSIS OF CONTENTS :

Atomic Weights and Factors—Useful Data—Chemical Calculations—Rules for Indirect Analysis—Weights and Measures—Thermometers and Barometers—Chemical Physics—Boiling Points, etc.—Solubility of Substances—Methods of Obtaining Specific Gravity—Conversion of Hydrometers—Strength of Solutions by Specific Gravity—Analysis—Gas Analysis—Water Analysis—Qualitative Analysis and Reactions—Volumetric Analysis—Manipulation—Mineralogy—Assaying—Alcohol—Beer—Sugar—Miscellaneous Technological matter relating to Potash, Soda, Sulphuric Acid, Chlorine, Tar Products, Petroleum, Milk, Tallow, Photography, Prices, Wages, etc., etc.

A Practical Treatise on Coal Mining. By GEORGE G. ANDRÉ, F.G.S., Assoc. Inst. C.E., Member of the Society of Engineers, with 82 lithographic plates. 2 vols., royal 4to, cloth, 3*l.* 12*s.*

CONTENTS :

I. Practical Geology—II. Coal, its Mode of Occurrence, Composition, and Varieties—III. Searching for Coal—IV. Shaft-sinking—V. Driving of Levels, or Narrow Work—VI. Systems of Working—VII. Getting the Coal—VIII. Haulage—IX. Winding—X. Drainage—XI. Ventilation—XII. Incidental Operations—XIII. Surface Work—XIV. Management and Accounts—XV. Characteristics of the Coal Fields of Great Britain and America.

Spons' Information for Colonial Engineers. Edited by J. T. HURST. Demy 8vo, sewed.

No. 1. Ceylon. By ABRAHAM DEANE, C.E. 2*s.* 6*d.*

CONTENTS :

Introductory Remarks—Natural Productions—Architecture and Engineering—Topography, Trade, and Natural History—Principal Stations—Weights and Measures, etc., etc.

No. 2. Southern Africa, including the Cape Colony, Natal, and the Dutch Republics. By HENRY HALL, F.R.G.S., F.R.C.I. With Map. 3*s.* 6*d.*

CONTENTS :

General Description of South Africa—Physical Geography with reference to Engineering Operations—Notes on Labour and Material in Cape Colony—Geological Notes on Rock Formation in South Africa—Engineering Instruments for Use in South Africa—Principal Public Works in Cape Colony: Railways, Mountain Roads and Passes, Harbour Works, Bridges, Gas Works, Irrigation and Water Supply, Lighthouses, Drainage and Sanitary Engineering, Public Buildings, Mines—Table of Woods in South Africa—Animals used for Draught Purposes—Statistical Notes—Table of Distances—Rates of Carriage, etc.

No. 3. India. By F. C. DANVERS, Assoc. Inst. C.E. With Map. 4*s.* 6*d.*

CONTENTS :

Physical Geography of India—Building Materials—Roads—Railways—Bridges—Irrigation—River Works—Harbours—Lighthouse Buildings—Native Labour—The Principal Trees of India—Money—Weights and Measures—Glossary of Indian Terms, etc.

The Clerk of Works; a Vade Mecum for all engaged in the Superintendence of Building Operations. By G. G. HOSKINS, F.R.I.B.A. Fcap. 8vo, cloth, 1s. 6d.

Coffee Planting in Southern India and Ceylon. By E. C. P. HULL. Crown 8vo, cloth, 9s.

Tropical Agriculture; or, the Culture, Preparation, Commerce, and Consumption of the Principal Products of the Vegetable Kingdom, as furnishing Food, Clothing, Medicine, etc., and in their relation to the Arts and Manufactures; forming a practical treatise and Handbook of Reference for the Colonist, Manufacturer, Merchant, and Consumer, on the Cultivation, Preparation for Shipment, and Commercial Value, etc., of the various Substances obtained from Trees and Plants entering into the Husbandry of Tropical and Sub-Tropical Regions. By P. L. SIMMONDS. Second Edition, revised and improved, in one thick vol. 8vo, cloth, 17. 1s.

Compensations; a Text-book for Surveyors, in tabulated form. By BANISTER FLETCHER. Crown 8vo, cloth, 5s.

CONTENTS:

The Varieties of Damage for which Claims may arise—Various Classes of Property Points to be observed in Surveys—Notices to Treat—Nature of Damage for which Claims can and cannot be sustained—What Property can be compulsorily taken—When Entry on Property can and cannot be compulsorily made—Of Goodwill and Stock—and of the various Legal Methods of Settlement of Disputed Claims—together with Full and Explicit Instructions on the Methods of Valuing and of Making Claims; with Comments on Cases arising under the Metropolis Local Management and Metropolitan Buildings Acts; the whole given in a Practical and Comprehensive Form, supplemented by a copious Appendix, containing many Useful Forms and Precedents, and also Tables for the Valuation of Freeholds, Leaseholds, Reversions, and Life-Interests.

Cotton Cultivation in its various details; the Barrage of Great Rivers, and Instructions for Irrigating, Embanking, Draining, and Tilling Land in Tropical and other Countries possessing high thermometric temperatures, especially adapted to the improvement of the cultural soils of India. By JOSEPH GIBBS, Member Institute Civil Engineers. With 5 plates. Crown 8vo, cloth, 7s. 6d.

Dilapidations; a Text-book for Architects and Surveyors, in Tabulated Form. By BANISTER FLETCHER, Fellow Royal Inst. Brit. Arch. (Author of 'Model Houses'), showing who are liable for Dilapidations, and the extent of the liability of Lessors, Lessees, Tenants at will, Tenants by elegit, Statute, Merchant, or Staple Tenants in fee simple, Tenants in tail, Tenants for life, Tenants for years without impeachment of Waste, Mortgagor, Mortgagee in possession, Yearly Tenants, Tenants in common, and joint Tenants, Rights of coparceners; also what are dilapidations and waste, and further fully instructs the surveyor how to take and value them, to which is added the duties of surveyors, with a table of legal cases, embracing the most recent, and illustrated throughout by examples drawn from the author's experience, and latest legal decisions. Crown 8vo, cloth, 5s.

Spons' Dictionary of Engineering, Civil, Mechanical, Military, and Naval; with technical terms in French, German, Italian, and Spanish, 3100 pp., and nearly 8000 engravings, in super-royal 8vo, in 8 divisions, 5*l.* 8*s.* Complete in 3 vols., cloth, 5*l.* 5*s.* Bound in a superior manner, half-morocco, top edge gilt, 3 vols., 6*l.* 12*s.*

A Treatise on the Origin, Progress, Prevention, and Cure of Dry Rot in Timber; with Remarks on the Means of Preserving Wood from Destruction by Sea-Worms, Beetles, Ants, etc. By THOMAS ALLEN BRITTON, late Surveyor to the Metropolitan Board of Works, etc., etc. Plates, crown 8vo, cloth, 7*s.* 6*d.*

A General Table for facilitating the Calculation of Earthworks for Railways, Canals, etc.; with a Table of Proportional Parts. By FRANCIS BASHFORTH, M.A., Fellow of St. John's College, Cambridge. In 8vo, cloth, with mahogany slide, 4*s.*

"This little volume sh.uld become the handbook of every person whose duties require even occasional calculations of this nature: were it only that it is more extensively applicable than any other in existence, we could cordially recommend it to our readers; but when they learn that the use of it involves only half the labour of all other Tables constituted for the same purposes, we offer the strongest of all recommendations—that founded on the value of time."—*Mechanic's Magazine*.

A General Sheet Table for facilitating the Calculation of Earthworks. By F. BASHFORTH, M.A. 6*d.*

A Handbook of Electrical Testing. By H. R. KEMPE, Assoc. of the Society of Telegraph Engineers. Fcap. 8vo, cloth, 5*s.*

Electricity; its Theory, Sources, and Applications. By JOHN T. SPRAGUE, Member of the Society of Telegraph Engineers. With 91 woodcuts and 30 valuable Tables. Crown 8vo, cloth, 8*s.*

Electricity and the Electric Telegraph. By GEORGE B. PRESCOTT. With 564 woodcut illustrations, 8vo, cloth, 18*s.*

Electro-Telegraphy. By FREDERICK S. BEECHEY, Telegraph Engineer, a Book for Beginners. Fcap. 8vo, cloth, 1*s.* 6*d.*

Engineering Papers. By GRAHAM SMITH. 8vo, cloth, 5*s.*

CONTENTS:

Mortar: "Miller Prize" Paper—Practical Ironwork: "Miller Prize" Paper—Retaining Walls: Paper read at the Edinburgh and Leith Engineers' Society. With Addenda and Discussions to each.

Spons' Engineers' and Contractors' Illustrated Book of Prices of Machines, Tools, Ironwork, and Contractors' Material. Royal 8vo, cloth, 7*s.* 6*d.*

The Gas Consumer's Handy Book. By WILLIAM RICHARDS, C.E. 18mo, sewed, 6*d.*

A Pocket-Book of Useful Formulae and Memoranda for Civil and Mechanical Engineers. By GUILFORD L. MOLESWORTH, Mem. Ins. C. E., Consulting Engineer to the Government of India for State Railways. Nineteenth edition, with a valuable contribution on Telegraphs by R. S. BROUH and Dr. PAGET HIGGS. 32mo, roan, 6s. Ditto, interleaved with ruled Paper for Office use, 9s. Ditto, printed on India paper, 6s.

SYNOPSIS OF CONTENTS:

Surveying, Levelling, etc.—Strength and Weight of Materials—Earthwork, Brickwork, Masonry, Arches, etc.—Struts, Columns, Beams, and Trusses—Flooring, Roofing, and Roof Trusses—Girders, Bridges, etc.—Railways and Roads—Hydraulic Formulae—Canals, Sewers, Waterworks, Docks—Irrigation and Breakwaters—Gas, Ventilation, and Warming—Heat, Light, Colour, and Sound—Gravity: Centres, Forces, and Powers—Millwork, Teeth of Wheels, Shafing, etc.—Workshop Recipes—Sundry Machinery—Animal Power—Steam and the Steam Engine—Water-power, Water-wheels, Turbines, etc.—Wind and Windmills—Steam Navigation, Ship Building, Tonnage, etc.—Gunnery, Projectiles, etc.—Weights, Measures, and Money—Trigonometry, Conic Sections, and Curves—Telegraphy—Mensuration—Tables of Areas and Circumference, and Arcs of Circles—Logarithms, Square and Cube Roots, Powers—Reciprocals, etc.—Useful Numbers—Differential and Integral Calculus—Algebraic Signs—Telegraphic Construction and Formulae.

"Most of our readers are already acquainted with Molesworth's Pocket-book, and not a few, we imagine, are indebted to it for valuable information, or for refreshers of the memory. The book has been re-arranged, the supplemental formulae and tables added since the first issue having now been incorporated with the body of the book in their proper positions, the whole making a handy size for the pocket. Every care has been taken to ensure correctness, both clerically and typographically, and the book is an indispensable *vade-mecum* for the mechanic and the professional man."—*English Mechanic*.

Spons' Tables and Memoranda for Engineers; selected and arranged by J. T. HURST, C.E., Author of 'Architectural Surveyors' Handbook,' 'Hurst's Tredgold's Carpentry,' etc. 64mo, roan, gilt edges, third edition, revised and improved, 1s. Or in cloth case, 1s. 6d.

This work is printed in a pearl type, and is so small, measuring only $2\frac{1}{2}$ in. by $1\frac{1}{4}$ in. by $\frac{1}{4}$ in. thick, that it may be easily carried in the waistcoat pocket.

"It is certainly an extremely rare thing for a reviewer to be called upon to notice a volume measuring but $2\frac{1}{2}$ in. by $1\frac{1}{4}$ in., yet these dimensions faithfully represent the size of the handy little book before us. The volume—which contains 118 printed pages, besides a few blank pages for memoranda—is, in fact, a true pocket-book, adapted for being carried in the waistcoat pocket, and containing a far greater amount and variety of information than most people would imagine could be compressed into so small a space. . . . The little volume has been compiled with considerable care and judgment, and we can cordially recommend it to our readers as a useful little pocket companion."—*Engineering*.

The French-Polisher's Manual. By a French-Polisher; containing Timber Staining, Washing, Matching, Improving, Painting, Imitations, Directions for Staining, Sizing, Embodying, Smoothing, Spirit Varnishing, French-Polishing, Directions for Re-polishing. Third edition, royal 32mo, sewed, 6d.

Analysis, Technical Valuation, Purification and Use of Coal Gas. By the Rev. W. R. BOWDITCH, M.A. With wood engravings, 8vo, cloth, 12s. 6d.

Condensation of Gas—Purification of Gas—Light—Measuring—Place of Testing Gas—Test Candles—The Standard for Measuring Gas-light—Test Burners—Testing Gas for Sulphur—Testing Gas for Ammonia—Condensation by Bromine—Gravimetric Method of taking Specific Gravity of Gas—Carburetting or Naphthalizing Gas—Acetylene—Explosions of Gas—Gnawing of Gaspipes by Rats—Pressure as related to Public Lighting, etc.

A Practical Treatise on the Manufacture and Distribution of Coal Gas. By WILLIAM RICHARDS. Demy 4to, with numerous wood engravings and large plates, cloth, 28s.

SYNOPSIS OF CONTENTS.

Introduction—History of Gas Lighting—Chemistry of Gas Manufacture, by Lewis Thompson, Esq., M.R.C.S.—Coal, by J. Paterson, Lewis Thompson, and G. R. Hislop, Esqrs.—Retorts, Iron and Clay—Retort Setting—Hydraulic Main—Condensers—Exhausters—Washers and Scrubbers—Purifiers—Purification—History of Gas Holder—Tanks, Brick and Stone, Composite, Concrete, Cast-iron, Compound, Annular Wrought-iron—Specifications—Gas Holders—Station Meter—Governor—Distribution—Mains—Gas Mathematics, or Formulae for the Distribution of Gas, by Lewis Thompson, Esq.—Services—Consumers' Meters—Regulators—Burners—Fittings—Photometer—Carburization of Gas—Air, Gas and Water Gas—Composition of Coal Gas, by Lewis Thompson, Esq.—Analyses of Gas—Influence of Atmospheric Pressure and Temperature on Gas—Residual Products—Appendix—Description of Retort Settings, Buildings, etc., etc.

Practical Geometry and Engineering Drawing; a Course of Descriptive Geometry adapted to the Requirements of the Engineering Draughtsman, including the determination of cast shadows and Isometric Projection, each chapter being followed by numerous examples; to which are added rules for Shading, Shade-lining, etc., together with practical instructions as to the Lining, Colouring, Printing, and general treatment of Engineering Drawings, with a chapter on drawing Instruments. By GEORGE S. CLARKE, Lieut. R.E., Instructor in Mechanical Drawing, Royal Indian Engineering College, Cooper's Hill. 20 plates, 4to, cloth, 15s.

The Elements of Graphic Statics. By Professor KARL VON OTT, translated from the German by G. S. CLARKE, Lieut. R.E., Instructor in Mechanical Drawing, Royal Indian Engineering College, Cooper's Hill. Crown 8vo, cloth, 5s.

A Practical Treatise on Heat, as applied to the Useful Arts; for the Use of Engineers, Architects, etc. By THOMAS BOX. Second edition, revised and enlarged, crown 8vo, cloth, 12s. 6d.

Hints to Young Engineers. By J. W. WILSON, A.I.C.E., Principal of the Crystal Palace School of Engineering. 12mo, sewed, 6d.

The New Formula for Mean Velocity of Discharge of Rivers and Canals. By W. R. KUTTER, translated from articles in the 'Cultur-Ingenieur.' By LOUIS D'A. JACKSON, Assoc. Inst. C.E. 8vo, cloth, 12s. 6d.

Office Hydraulic Tables; for the use of Engineers engaged in Waterworks, giving the Discharge and Dimensions of Rivers, Channels, and Pipes. By J. NEVILLE. On a large folio sheet, 1s.

Hydraulics of Great Rivers; being Observations and Surveys on the Largest Rivers of the World. By J. J. REVY. Imp. 4to, cloth, with eight large plates and charts, 2l. 2s.

Hops, their Cultivation, Commerce, and Uses in various Countries. By P. L. SIMMONDS. Crown 8vo, cloth, 4s. 6d.

Practical Hydraulics; a Series of Rules and Tables for the use of Engineers, etc., etc. By THOMAS BOX. Fourth edition, numerous plates, post 8vo, cloth, 5s.

The Indicator Diagram Practically Considered. By N. P. BURGH, Engineer. Numerous illustrations, fifth edition. Crown 8vo, cloth, 6s. 6d.

"This volume possesses one feature which renders it almost unique; this feature is the mode in which it is illustrated. It is not difficult to take a diagram if the instrument is once set, and the setting with stationary engines is occasionally easy enough, but circumstances continually arise under which the young engineer is completely at a loss as to how to obtain a diagram. All uncertainty will be removed by referring to the book under consideration: here we have drawings of the arrangements to be adopted under every conceivable circumstance, drawings, we may add, illustrating the practice of the best engineers of the day." —Engineer.

Link-Motion and Expansion Gear Practically Considered. By N. P. BURGH, Engineer. Illustrated with 90 plates and 229 wood engravings, small 4to, handsomely half-bound in morocco, 2l. 2s.

The Mechanician and Constructor for Engineers, comprising Forging, Planing, Lining, Slotting, Shaping, Turning, Screw Cutting, etc. By CAMERON KNIGHT. Containing 96 plates, 1147 illustrations, and 397 pages of letterpress, 4to, half-morocco, 2l. 12s. 6d.

The Essential Elements of Practical Mechanics; based on the Principle of Work, designed for Engineering Students. By OLIVER BYRNE, formerly Professor of Mathematics, College for Civil Engineers. Second edition, illustrated by numerous wood engravings, post 8vo, cloth, 7s. 6d.

CONTENTS:

Chap. 1. How Work is Measured by a Unit, both with and without reference to a Unit of Time—Chap. 2. The Work of Living Agents, the Influence of Friction, and introduces one of the most beautiful Laws of Motion—Chap. 3. The principles expounded in the first and second chapters are applied to the Motion of Bodies—Chap. 4. The Transmission of Work by simple Machines—Chap. 5. Useful Propositions and Rules.

The Practical Millwright's and Engineer's Ready Ruckoner; or Tables for finding the diameter and power of cog-wheels, diameter, weight, and power of shafts, diameter and strength of bolts, etc. By THOMAS DIXON. Fourth edition, 12mo, cloth, 3s.

CONTENTS:

Diameter and Power of Wheels—Diameter, Weight, and Power of Shafts—Multipliers for Steam used Expansively—Diameters and Strength of Bolts—Size and Weight of Hexagonal Nuts—Speed of Governors for Steam Engines—Contents of Pumps—Working Barrels—Circumferences and Areas of Circles—Weight of Boiler Plates—French and English Weights and Measures, etc.

The Principles of Mechanics and their Application to Prime Movers, Naval Architecture, Iron Bridges, Water Supply, etc. By W. J. MILLAR, C.E., Secretary to the Institution of Engineers and Ship-builders, Scotland. Crown 8vo, cloth, 4s. 6d.

A Practical Treatise on Mill-gearing, Wheels, Shafts, Riggers, etc.; for the use of Engineers. By THOMAS BOX. Crown 8vo, cloth, second edition, 7s. 6d.

Mining Machinery; a Descriptive Treatise on the Machinery, Tools, and other Appliances used in Mining. By G. G. ANDRÉ, F.G.S., Assoc. Inst. C.E., Mem. of the Society of Engineers. Royal 4to, uniform with the Author's Treatise on Coal Mining, containing 182 plates, accurately drawn to scale, with descriptive text, in 2 vols., cloth, 3l. 12s. **CONTENTS:**

Machinery for Prospecting, Excavating, Hauling, and Hoisting—Ventilation—Pumping—Treatment of Mineral Products, including Gold and Silver, Copper, Tin, and Lead, Iron, Coal, Sulphur, China Clay, Brick Earth, etc.

The Pattern Maker's Assistant; embracing Lathe Work, Branch Work, Core Work, Sweep Work, and Practical Gear Construction, the Preparation and Use of Tools, together with a large collection of Useful and Valuable Tables. By JOSHUA ROSE, M.E. With 250 illustrations. Crown 8vo, cloth, 10s. 6d.

The Science and Art of the Manufacture of Portland Cement, with observations on some of its constructive applications, with numerous illustrations. By HENRY REID, C.E., Author of 'A Practical Treatise on Concrete,' etc., etc. 8vo, cloth, 18s.

The Draughtsman's Handbook of Plan and Map Drawing; including instructions for the preparation of Engineering, Architectural, and Mechanical Drawings. With numerous illustrations in the text, and 33 plates (15 printed in colours). By G. G. ANDRÉ, F.G.S., Assoc. Inst. C.E. 4to, cloth, 15s.

CONTENTS:

The Drawing Office and its Furnishings—Geometrical Problems—Lines, Dots, and their Combinations—Colours, Shading, Lettering, Bordering, and North Points—Scales—Plotting—Civil Engineers' and Surveyors' Plans—Map Drawing—Mechanical and Architectural Drawing—Copying and Reducing Trigonometrical Formulae, etc., etc.

The Railway Builder; a Handbook for Estimating the Probable Cost of American Railway Construction and Equipment. By WILLIAM J. NICOLLS, Civil Engineer. Illustrated, full bound, pocket-book form, 7s. 6d.

Rock Blasting: a Practical Treatise on the means employed in Blasting Rocks for Industrial Purposes. By G. G. ANDRÉ, F.G.S., Assoc. Inst. C.E. With 56 illustrations and 12 plates, 8vo, cloth, 10s. 6d.

*Surcharged and different Forms of Retaining Walls.*By J. S. TATE. *Cuts*, 8vo, sewed, 2s.

A Treatise on Ropemaking as practised in public and private Rope-yards, with a Description of the Manufacture, Rules, Tables of Weights, etc., adapted to the Trade, Shipping, Mining, Railways, Builders, etc. By R. CHAPMAN, formerly foreman to Messrs. Huddart and Co., Limehouse, and late Master Ropemaker to H.M. Dockyard, Deptford. Second edition, 12 mo, cloth, 3s.

Sanitary Engineering; a Series of Lectures given before the School of Engineering, Chatham. Division I. Air.—Division II. Water.—Division III. The Dwelling.—Division IV. The Town and Village.—Division V. The Disposal of Sewage. Copiously illustrated. By J. BAILEY DENTON, C.E., F.G.S., Honorary Member of the Agricultural Societies of Norway, Sweden, and Hanover, and Author of the 'Farm Homesteads of England,' 'Village Sanitary Economy,' 'Storage of Water,' 'Sewage Farming,' etc. Royal 8vo, cloth, 25s.

Sanitary Engineering; a Guide to the Construction of Works of Sewerage and House Drainage, with Tables for facilitating the calculations of the Engineer. By BALDWIN LATHAM, C.E., M. Inst. C.E., F.G.S., F.M.S., Past-President of the Society of Engineers. Second edition, with numerous plates and woodcuts, 8vo, cloth, 1*l.* 10*s.*

Cleaning and Scouring; a Manual for Dyers, Laundresses, and for Domestic Use. By S. CHRISTOPHER. 18mo, sewed, 6*d.*

A Practical Treatise on modern Screw-Propulsion. By N. P. BURGH, Engineer. Illustrated with 52 large plates and 103 woodcuts, 4to, half-morocco, 2*l.* 2*s.*

Screw Cutting Tables for Engineers and Machinists, giving the values of the different trains of Wheels required to produce Screws of any pitch, calculated by Lord Lindsay, M.P., F.R.S., F.R.A.S., etc. Royal 8vo, cloth, oblong, 2*s.*

Screw Cutting Tables, for the use of Mechanical Engineers, showing the proper arrangement of Wheels for cutting the Threads of Screws of any required pitch, with a Table for making the Universal Gas-pipe Threads and Taps. By W. A. MARTIN, Engineer. Second edition, royal 8vo, oblong, cloth, 1*s.*

Vazeeri Rupi, the Silver Country of the Vazeers, in Kulu: its Beauties, Antiquities, and Silver Mines, including a Trip over the lower Himalayah Range and Glaciers. By J. CALVERT, F.G.S., Mem. Inst. C.E. Illustrated with a map and coloured plates, 8vo, cloth, 16*s.*

A Treatise on a Practical Method of Designing Slide Valve Gears by Simple Geometrical Construction, based upon the principles enunciated in Euclid's Elements, and comprising the various forms of Plain Slide Valve and Expansion Gearing; together with Stephenson's, Gooch's, and Allan's Link-Motions, as applied either to reversing or to variable expansion combinations. By EDWARD J. COWLING WELCH, Memb. Inst. Mechanical Engineers. Crown 8vo, cloth. 6s.

The Slide Valve practically considered. By N. P. BURGH, Engineer. Seventh edition, containing 88 illustrations, and 121 pages of letterpress, crown 8vo, cloth, 5s.

A Pocket-Book for Boiler Makers and Steam Users, comprising a variety of useful information for Employer and Workman, Government Inspectors, Board of Trade Surveyors, Engineers in charge of Works and Slips, Foremen of Manufactories, and the general Steam-using Public. By MAURICE JOHN SEXTON. Royal 32mo, roan, gilt edges, 5s.

Practical Treatise on Steam Boilers and Boiler Making. By N. P. BURGH, Mem. Inst. Mec. Eng. Illustrated by 1163 wood engravings and 50 large folding plates of working drawings, royal 4to, half-morocco, 3l. 13s. 6d.

Modern Compound Engines; being a Supplement to *Modern Marine Engineering*. By N. P. BURGH, Mem. Inst. Mech. Eng. Numerous large plates of working drawings, 4to, cloth, 18s.

The following Firms have contributed Working Drawings of their best and most modern examples of Engines fitted in the Royal and Mercantile Navies: Messrs. Maudslay, Rennie, Watt, Dudgeon, Humphreys, Ravenhill, Jackson, Perkins, Napier, Elder, Laird, Day, Allibon.

A Practical Treatise on the Steam Engine, containing Plans and Arrangements of Details for Fixed Steam Engines, with Essays on the Principles involved in Design and Construction. By ARTHUR RIGG, Engineer, Member of the Society of Engineers and of the Royal Institution of Great Britain. Demy 4to, copiously illustrated with woodcuts and 96 plates, in one Volume, half-bound morocco, 2l. 2s.

This work is not, in any sense, an elementary treatise, or history of the steam engine, but is intended to describe examples of Fixed Steam Engines without entering into the wide domain of locomotive or marine practice. To this end illustrations will be given of the most recent arrangements of Horizontal, Vertical, Beam, Pumping, Winding, Portable, Semi-portable, Corliss, Allen, Compound, and other similar Engines, by the most eminent Firms in Great Britain and America. The laws relating to the action and precautions to be observed in the construction of the various details, such as Cylinders, Pistons, Piston-rods, Connecting-rods, Cross-heads, Motion-blocks, Eccentrics, Simple, Expansion, Balanced, and Equilibrium Slide-valves, and Valve-gearing will be minutely dealt with. In this connection will be found articles upon the Velocity of Reciprocating Parts and the Mode of Applying the Indicator, Heat and Expansion of Steam Governors, and the like. It is the writer's desire to draw illustrations from every possible source, and give only those rules that present practice deems correct.

The Steam Engine considered as a Heat Engine: a Treatise on the Theory of the Steam Engine, illustrated by Diagrams, Tables, and Examples from Practice. By JAS. H. COTTERILL, M.A., Professor of Applied Mechanics in the Royal Naval College. 8vo, cloth, 12s. 6d.

Modern Marine Engineering applied to Paddle and Screw Propulsion; consisting of 36 plates, 259 wood engravings, and 403 pages of descriptive matter, the whole being an exposition of the present practice of the following firms: Messrs. J. Penn and Sons; Maudslay, Sons, and Field; James Watt and Co.; J. and G. Rennie; R. Napier and Sons; J. and W. Dudgeon; Ravenhill and Hodgson; Humphreys and Tennant; Mr. J. F. Spencer; and Messrs. Forester and Co. By N. P. BURGH, Engineer, 4to, cloth, 2l. 5s.

A Pocket-Book of Practical Rules for the Proportions of Modern Engines and Boilers for Land and Marine purposes. By N. P. BURGH. Sixth edition, revised, with Appendix, royal 32mo, roan, 4s. 6d.

Details of High-Pressure Engine, Beam Engine, Condensing, Marine Screw Engines, Oscillating Engines, Valves, etc., Land and Marine Boilers, Proportions of Engines produced by the Rules, Proportions of Boilers, etc.

A Practical Treatise on the Science of Land and Engineering Surveying, Levelling, Estimating Quantities, etc., with a general description of the several Instruments required for Surveying, Levelling, Plotting, etc. By H. S. MERRETT. 41 fine plates with Illustrations and Tables, royal 8vo, cloth, third edition, 12s. 6d.

PRINCIPAL CONTENTS :

Part 1. Introduction and the Principles of Geometry. Part 2. Land Surveying: comprising General Observations—The Chain—Offsets Surveying by the Chain only—Surveying Hilly Ground—To Survey an Estate or Parish by the Chain only—Surveying with the Theodolite—Mining and Town Surveying—Railroad Surveying—Mapping—Division and Laying out of Land—Observations on Enclosures—Plane Trigonometry. Part 3. Levelling—Simple and Compound Levelling—The Level Book—Parliamentary Plan and Section—Levelling with a Theodolite—Gradients—Wooden Curves—To Lay out a Railway Curve—Setting out Widths. Part 4. Calculating Quantities generally for Estimates—Cuttings and Embankments—Tunnels—Brickwork—Ironwork—Timber Measuring. Part 5. Description and Use of Instruments in Surveying and Plotting—The Improved Dumpy Level—Troughton's Level—The Prismatic Compass—Proportional Compass—Box Sextant—Vernier—Pantograph—Merrett's Improved Quadrant—Improved Computation Scale—The Diagonal Scale—Straight Edge and Sector. Part 6. Logarithms of Numbers—Logarithmic Sines and Co-Sines, Tangents and Co-Tangents—Natural Sines and Co-Sines—Tables for Earthwork, for Setting out Curves, and for various Calculations, etc., etc., etc.

The Chemistry of Sulphuric Acid Manufacture. By HENRY ARTHUR SMITH. Cuts, crown 8vo, cloth, 4s. 6d.

CONTENTS :

Ground Plan of Kilns for Burning Sulphur Ores—Section of Pyrites Furnace—On the Presence of Arsenic—Methods for Removal of Arsenic—An Experimental Examination of the Circumstances which determine the Action of the Gases in the Lead Chamber—On the Distribution of Gases in the Lead Chamber—On the Temperature at which Nitric Acid acts upon Sulphurous Acid—On the Distribution of Heat in the Lead Chamber—An Inquiry into the Best Form of Leaden Chamber, etc.

The Principles and Practice of Engineering, Trigonometrical, Subterraneous, and Marine Surveying. By CHARLES BOURNE, C.E. Third edition, numerous plates and woodcuts, 8vo, cloth, 5s.

Table of Logarithms of the Natural Numbers, from 1 to 108,000. By CHARLES BABBAGE, Esq., M.A. Stereotyped edition, royal 8vo, cloth, 7s. 6d.

To ensure the correctness of these Tables of Logarithms, they were compared with Callett's, Vega's, Hutton's, Briggs', Gardiner's, and Taylor's Tables of Logarithms, and carefully read by nine different readers; and further, to remove any possibility of an error remaining, the stereotyped sheets were hung up in the Hall at Cambridge University, and a reward offered to anyone who could find an inaccuracy. So correct are these Tables, that since their first issue in 1827 no error has been discovered.

BARLOW'S Tables of Squares, Cubes, Square Roots, Cube Roots, Reciprocals of all Integer Numbers up to 10,000. Post 8vo, cloth, 6s.

CAMUS (M.) *Treatise on the Teeth of Wheels*, demonstrating the best forms which can be given to them for the purposes of Machinery, such as Mill-work and Clock-work, and the art of finding their numbers, translated from the French. Third edition, carefully revised and enlarged, with details of the present practice of Millwrights, Engine Makers, and other Machinists. By ISAAC HAWKINS. Illustrated by 18 plates, 8vo, cloth, 5s.

The Practical Sugar Planter; a complete account of the Cultivation and Manufacture of the Sugar Cane, according to the latest and most approved processes, describing and comparing the different systems pursued in the East and West Indies and the Straits of Malacca, and the relative expenses and advantages attendant upon each, being the result of sixteen years' experience as a Sugar Planter in those Countries. By LEONARD WRAY, Esq. 8vo, cloth, 10s. 6d.

Laying and Repairing Electric Telegraph Cables. By Capt. V. HOSKIER, Royal Danish Engineers. Crown 8vo, cloth, 3s. 6d.

The Practice of Hand Turning in Wood, Ivory, Shell, etc., with Instructions for Turning such Work in Metal as may be required in the Practice of Turning in Wood, Ivory, etc., also an Appendix on Ornamental Turning. By FRANCIS CAMPIN. Second edition, with wood engravings, crown 8vo, cloth (a book for beginners), 6s.

CONTENTS :

On Lathes—Turning Tools—Turning Wood—Drilling—Screw Cutting—Miscellaneous Apparatus and Processes—Turning Particular Forms—Staining—Polishing—Spinning Metals—Materials—Ornamental Turning, etc.

Health and Comfort in House Building, or Ventilation with Warm Air by Self-Acting Suction Power, with Review of the mode of Calculating the Draught in Hot-Air Flues, and with some actual Experiments. By J. DRYSDALE, M.D., and J. W. HAYWARD, M.D. Second edition, with Supplement, demy 8vo, with plates, cloth, 7s. 6d.; the Supplement separate, 6d.

Treatise on Valve-Gears, with special consideration of the Link-Motions of Locomotive Engines. By Dr. GUSTAV ZEUNER. Third edition, revised and enlarged, translated from the German, with the special permission of the author, by MORITZ MÜLLER. Plates, 8vo, cloth, 12s. 6d.

Treatise on Watchwork, Past and Present. By the Rev. H. L. NELTHROPP, M.A., F.S.A. Numerous illustrations, crown 8vo, cloth, 6s. 6d.

CONTENTS :

Definitions of Words and Terms used in Watchwork—Tools—Time—Historical Summary—On Calculations of the Numbers for Wheels and Pinions; their Proportional Sizes, Trains, etc.—Of Dial Wheels, or Motion Work—Length of Time of Going without Winding up—The Verge—The Horizontal—The Duplex—The Lever—The Chronometer—Repeating Watches—Keyless Watches—The Pendulum, or Spiral Spring—Compensation—Jewelling of Pivot Holes—Clerkenwell—Fallacies of the Trade—Incapacity of Workmen—How to Choose and Use a Watch, etc.

The Present Practice of Sinking and Boring Wells, with Geological Considerations and Examples of Wells. By ERNEST SPON, Member of the Society of Engineers, of the Franklin Institute, of the Iron and Steel Institute, and of the Geologists' Association. Crown 8vo, cloth, illustrated by 276 diagrams and engravings to scale, 7s. 6d.

Workshop Receipts for Manufacturers, Mechanics, and Scientific Amateurs. By ERNEST SPON. With numerous illustrations, 450 pp., crown 8vo, cloth, 5s.

CONTAINING RECEIPTS FOR

Bookbinding—Bronzes and Bronzing—Candles—Cement—Cleaning—Colour-washing—Concretes—Dipping Acids—Drawing Office Details—Drying Oils—Dyeing—Dynamite—Electro-Metallurgy (Cleaning, Dipping, Scratch-brushing, Batteries, Baths, and Deposits of every description)—Enamels—Engraving on Wood, Copper, Gold, Silver, Steel, and Stone—Etching and Aqua Tint—Firework Making (Rockets, Stars, Rains, Gerbes, Jets, Tourbillons, Candles, Fires, Lances, Lights, Wheels, Fire-balloons, and minor Fireworks)—Fluxes—Foundry Mixtures—Freezing—Fulminates—Furniture Creams, Oils, Polishes, Lacquers, and Pastes—Gilding—Glass Cutting, Cleaning, Frosting, Drilling, Darkening, Bending, Staining, and Painting—Glass Making—Glues—Gold—Graining—Gums—Gun Cotton—Gunpowder—Horn Working—Indiarubber—Ink (Writing and Printing)—Japans, Japanning, and kindred processes—Lacquers—Lathing—Leather—Lubricants—Marble Working—Matches—Mortars—Nitro-Glycerine—Oils—Paper—Paper Hanging—Painting in Oils, in Water Colours, as well as Fresco, House, Transparency, Sign, and Carriage Painting—Photography—Pigments—Plastering—Polishes—Pottery (Clays, Bodies, Glazes, Colours, Oils, Stains, Fluxes, Enamels, and Lustres)—Scouring—Silvering—Soap—Solders—Tanning—Taxidermy—Tempering Metals—Treating Horn, Mother-o'Pearl, and like substances—Varnishes, Manufacture and Use of—Veneering—Washing—Waterproofing—Welding—Whitewashing. —Besides Receipts relating to the lesser Technological matters and processes, such as the Manufacture and Use of Stencil Plates, Blacking, Crayons, Paste, Putty, Wax, Size, Alloys, Catgut, Tunbridge Ware, Picture Frame and Architectural Mouldings, Compos, Cameos, and others too numerous to mention.

**THE TRANSACTIONS OF THE SOCIETY OF
ENGINEERS.**

Published Annually. 8vo, cloth, price 15s.

**THE JOURNAL OF THE IRON AND STEEL
INSTITUTE.**

Published Half-yearly. 8vo, sewed, price 7s. 6d.

**THE JOURNAL OF THE SOCIETY OF TELEGRAPH
ENGINEERS.**

Published Quarterly. 8vo, sewed, price 7s. 6d.

**THE PROCEEDINGS OF THE ASSOCIATION OF SANITARY
AND MUNICIPAL ENGINEERS AND SURVEYORS.**

Published Annually. 8vo, cloth, price 10s. 6d.

NOW IN COURSE OF PUBLICATION.

To be completed in about 30 Monthly Parts, each Part containing 64 pp.,
with *numerous illustrations*, super-royal 8vo, price 2s.

SPONS' ENCYCLOPÆDIA
OF THE
INDUSTRIAL ARTS, MANUFACTURES, AND COMMERCIAL
PRODUCTS.

EDITED BY GEO. G. ANDRÉ, F.G.S., Assoc. INST. C.E.

NOW IN COURSE OF PUBLICATION.

To be completed in about 15 Monthly Parts, each Part containing 64 pp.,
with *numerous illustrations*, super-royal 8vo, price 2s.

A SUPPLEMENT

TO

SPONS' DICTIONARY OF ENGINEERING,
CIVIL, MECHANICAL, MILITARY, AND NAVAL.

EDITED BY ERNEST SPON, MEMB. SOC. ENGINEERS.

London: E. & F. N. SPON, 46, Charing Cross.

New York: 446, Broome Street.

